ing the *passonata* and the project of restoring the navigability of the Tiber, and they had become interested in Meijer's other inventions too. Meijer does not say who they were, but he does mention in the book Giovanni Giustino Ciampini, a high official at the papal court and a well-known scholar. Ciampini (1633–98) is mainly known for his research on the churches of the early Middle Ages, but he was also interested in modern science.[14] His house

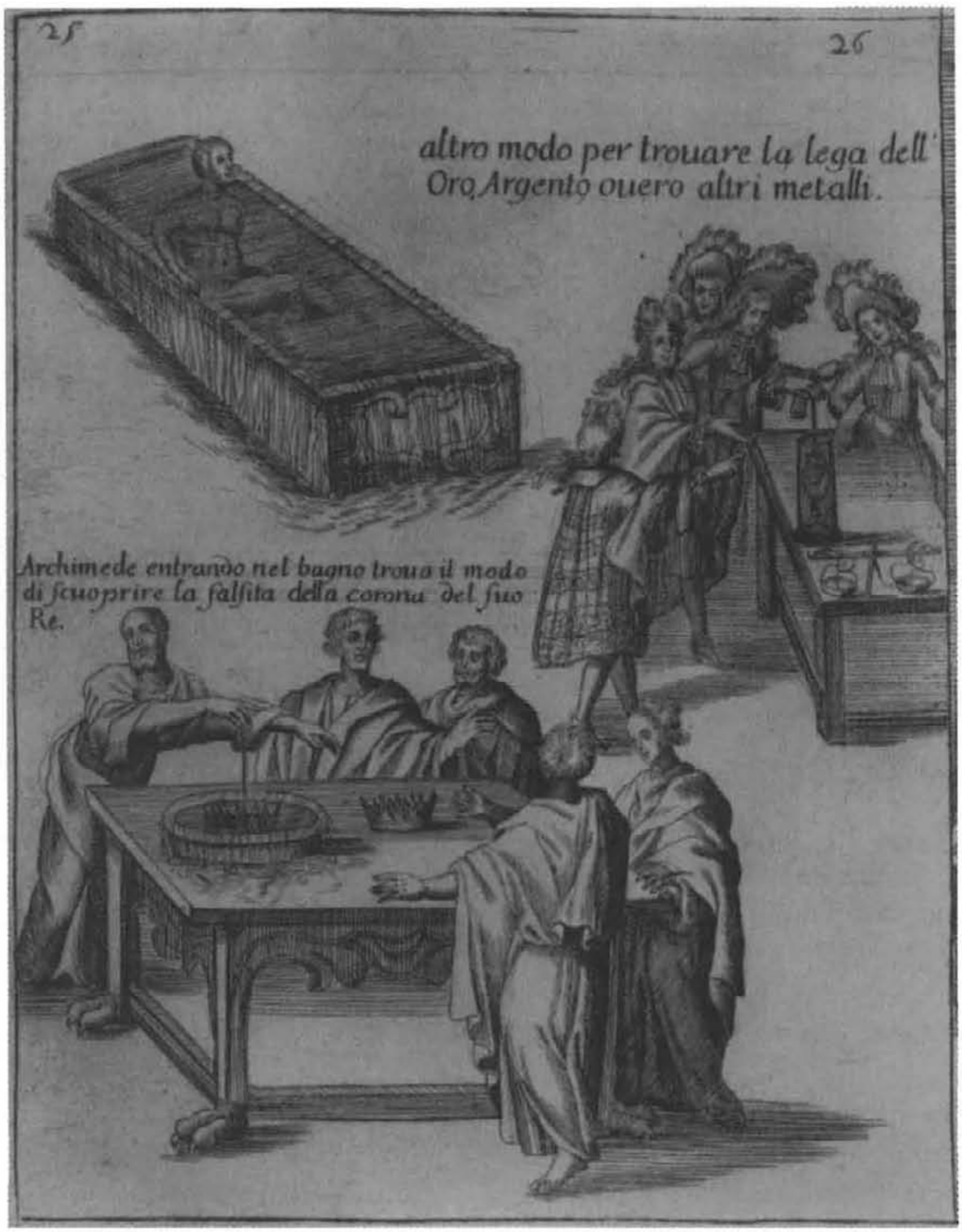

Figure 11.3 Old ways and new ways to discover the amount of gold in a certain piece of metal. From Cornelis Meijer, *Nuovi ritrovamenti* (Rome, 1689). Copyright © University Library Leiden.

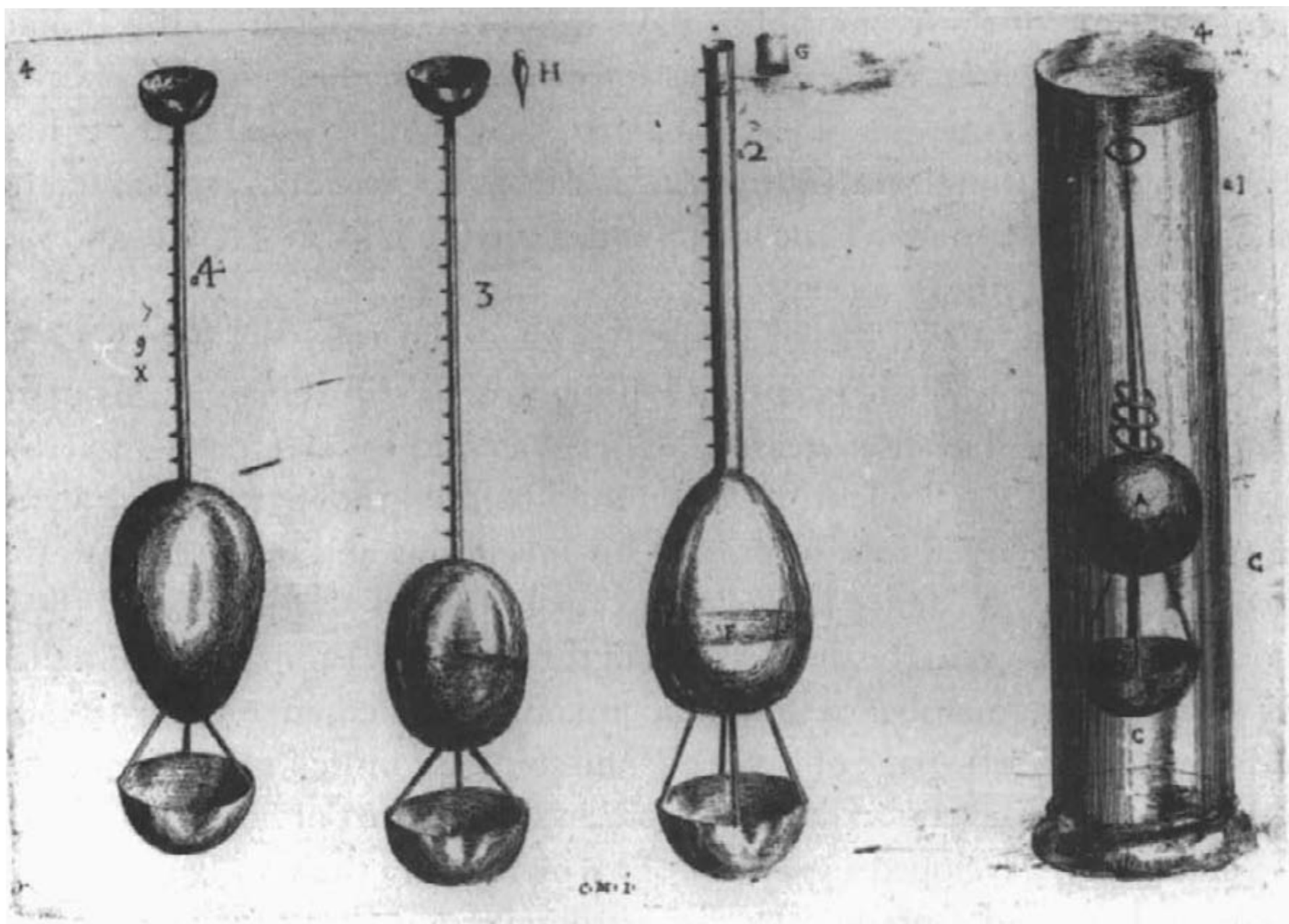

Figure 11.1 Instruments invented by Meijer to discover the amount of gold in a certain piece of metal. From Cornelis Meijer, *L'arte di restituire* (Rome, 1685).
Copyright © Amsterdam University Library.

near the S. Agnese in Agone was already the meeting place of a number of learned circles when in 1677 Ciampini, in conscious imitation of the defunct Florentine Accademia del Cimento, also founded a society for the cultivation of natural science, the Accademia Fisicomatematica Romana. Ciampini owned a decent collection of scientific instruments, which he put at the disposal of the members of his academy. Although it had no official charter (even its name varied over time), the meetings of the Accademia were regulated according to strict rules. The members met every week, one of the members acted as secretary, and the discussions and suggestions for further research were carefully recorded in a large notebook, which is still extant (at least in part). Many of the members of this group of virtuosi were simply amateurs, but a small number of them might be called professionals. The Jesuit Francesco Eschinardi, professor of mathematics at the Collegio Romano and highly regarded for his astronomical research, was perhaps the most important of these professionals.[15] Although the first secretary of the Accademia had the intention to publish the minutes of the meetings, just as the Accademia del Cimento had done, the Roman Accademia as such never published anything. But some members did, for instance Eschinardi, who in the 1680s published several short pamphlets about his observations of several

comets. Some of these pamphlets have the form of a letter to the Italian astronomer Giovanni Domenico Cassini, who was in charge of the obervatory of the Académie des Science at Paris. Through personal contacts like these, but also through the *Giornale de' Letterati*, a learned journal edited by Ciampini, the Accademia Fisicomatematica tried to inform scholars and scientists outside Rome of its existence and its activities.[16]

Ciampini introduced Meijer to the Accademia in 1680, not only because of his construction of the *passonata* (although that still remained his main claim to fame),[17] but also because Meijer was said to have been an active member of the Dutch scientific community before his departure to Italy in 1674. Ciampini urged him to present his inventions and discoveries to the Accademia, and as Meijer relates in his book, Ciampini also deemed them worthy of inclusion in the proceedings of the academy. From then on Meijer was a prominent member of the Accademia Fisicomatematica, as he proudly indicated on the title page of his book, and to please his fellow academicians he also included several of his inventions in the last part of his book.

Meijer soon developed a specialty of his own. From the very beginning he seems to have had a prediliction for astronomy and for the observation of comets more in particular (part of the design for the new pavement of the St. Peter's Square was a list of all comets since Christ's birth up to the seventeenth century). Coincidentally, in 1680 and 1682 two (some thought three) beautiful comets appeared in the skies, and Meijer had a perfect opportunity to show the other members of the academy his expertise and his knowledge of the literature.[18] And although we should not overestimate Meijer's astronomical expertise, with the help once more of some of his Dutch friends (Abraham Genoels, a painter known for his mathematical skills) he was at least able to draw some very detailed figures of the course of some comets in his later publications (fig. 11.5). But he certainly did not restrict himself to comets. If we compare the notebooks of the first secretary of the academy and the publications of some of the members, the correspondences with the contents of Meijer's books are remarkable. The experimental work of Torricelli and that of Boyle were much discussed by the members of academy and also play a prominent part in Meijer's later works.

The works Meijer published after 1685 all follow more or less the same pattern. In 1689 he published his *Nuovi ritrovamenti* (New discoveries), essentially a collection of new inventions of very diverse character.[19] This book was expanded and republished in 1696 as his *Nuovi ritrovamenti divisi in due parti*, while in the same year he published his *L'arte di rendere i fiumi navigabili in varii modi, con altre nuove inventioni e varii altri secreti, divisa in tre parti* (The art or making the rivers navigable in various ways, with other new inventions and several other secrets, divided in three parts). Actually, these books are not really new books, because each new book consists of a

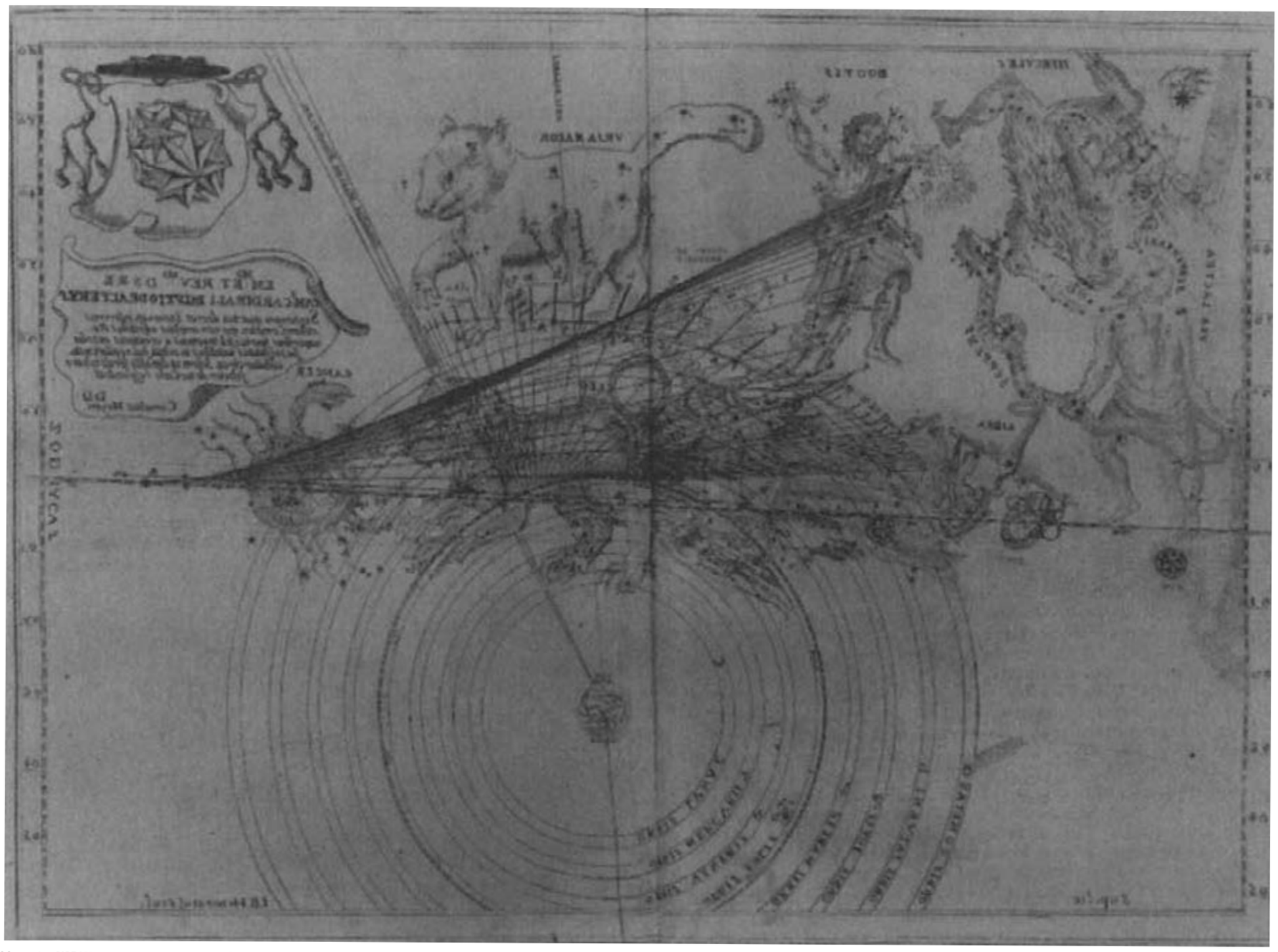

Figure 11.5 Meijer's representation of the orbits of the comets of 1682 and 1684. From Cornelis Meijer, *Nuovi ritrovamenti* (Rome, 1689). Copyright © University Library Leiden.

reprint of the former with a number of new topics and illustrations added. In general, the new material consists of two kinds of information. The first concerns new technical inventions. Meijer was hired for solving all kinds of problems all over Italy, and the results were incorporated in the new editions. The second kind of additions concerns material that had been discussed in the Accademia Fisicomatematica. There are no notebooks of the academy after the first two years, but we can reasonably assume that Meijer's books are at least in part reproducing what the members of Ciampini's academy had been discussing in the 1680s and 1690s. Of course, the books were Meijer's, and he adhered to the format he had already chosen for his *L'arte di restituire*. But we may safely assume that the other members liked his books for that very reason, because the heavy stress on the visual representation of the new experimental science was just what they needed. None of the other members is known for his artistic or representational skills; all their pamphlets are purely verbal reports on their research. Meijer is the only member with the talents to draw his own illustrations and as a craftsman-become-virtuoso the language of art was his favorite means of presenting the result of the work of the academy to the learned world. His explanations are a

rambling concoction of new and old knowledge, including some fragments from ancient authors whom he evidently was not able to read, but his drawings are detailed, lifelike, and trustworthy representations of instruments and experiments. His limitations therefore were, at least in the context of the new science, at the same time his main assets.

DEFENSE AND DEFEAT

With the publication of *L'arte di restituire* Meijer undoubtedly had in mind to show the world that he was not just a plain Dutch engineer, unskilled in the arts and the sciences, but a member of the scientific elite of Rome. That is why on the title page he proudly announced himself as a member "dell' Accademia Fisicomatematica Romana." From the contents of the book it is clear that Meijer even pretended to be an architect, just as Fontana was, and it is no coincidence that he especially dwelled on the reconstruction of the pavement of St. Peter's Square, because his arch enemy Fontana had just begun to write an impressive book about St. Peter's Church.

Meijer's book certainly was a success, but his new standing as a virtuoso seemed only to rekindle the feud between Meijer and Fontana rather than end it. The rivalry between the two men appears to have inspired both of them to compose new books—books they might not have contemplated if they had not needed material to counter each other's charges. Meijer in this conflict was the underdog, but it is remarkable that Fontana, who by now had become the most important architect of Rome, an all-round artist who was in the process of seeing through the press his monumental work on St. Peter's Church, still was trying to ruin the career of someone who, as far as we can see at least, did not pose any real threat anymore to his reputation. In 1694 and in 1697 Fontana and his followers once again openly charged Meijer of having used the wrong material for his *passonata*, suggesting that within a short while it would collapse after all.[20] New investigations were ordered, with the same result as before: there was nothing wrong with the *passonata*.

Apparently, Meijer was not sure that this would be the last time that he and his *passonata* were to be criticized by Fontana and his followers. Although he had already written several memoranda to defend his *passonata*, he now mobilized all his connections in Rome to deal a final blow to all his critics and collect all the money the papal government owed him. With the linguistic, rhetorical, and juridical help of the Roman lawyer Francesco Maria Onorati, a member of the Accademia Fisicomatematica and someone who had helped Meijer before, in 1698 the engineer published an enlarged edition of an earlier Latin *Memoriale* as his *Apologia per la passonata*

fatta sopra il Tevere fuori di Porta del Popolo in difesa della strada Flaminiana.[21] This publication is a very detailed and rhetorically very sophisticated reconstruction and defense of Meijer's career in Rome, with special emphasis on his building the *passonata*. The self-presentation in this volume is somewhat different compared to Meijer's other publications. He repeats the story about the *passonata* and the obstructions he had encountered during and after its construction. But he also has his readers believe that he is a descendant of a rich aristocratic family in Holland, his brother being the viceroy of the Dutch East Indies. There is no independent evidence to confirm these claims, quite the opposite, but it is clear that Meijer in his *Apologia* publicly posed as an aristocrat who was not treated accordingly by the papal bureaucrats and their Italian clients, Fontana being one of them. Fontana himself is not attacked right away; although his name is not mentioned, the architect (referred to as 'un gran Virtuoso') is even praised for his fine knowledge of architecture. But in the second half of the *Apologia* Meijer subtly points out that Fontana had overseen some details that were crucial to the construction of the *passonata* and that only the superior technical expertise of Meijer, who stood in the tradition of the celebrated Dutch engineers, had been able to build a construction strong enough to withstand the pressure of the water in the river.

In the end, Meijer was able to ward off all the charges brought against him by Fontana and others, but in an indirect way, Fontana did succeed in ruining Meijer's career in Rome. Even though the Dutch engineer proved to be able to execute several difficult constructions in several places in Italy, he never obtained the rewards promised to him by the papal administration. He constantly had to pay for his expenditures from his own pocket. In the *Apologia* he complains how he had to sell his cabinet of curiosities in Amsterdam just to stay alive in Rome. We are not able to verify this story, but it is quite sure that dealing with the pope ruined Meijer financially.

Lack of success is also what characterizes Meijer's efforts to drain the Pontine marshes—another proposal worthy of a Dutch engineer.[22] Though others had tried to drain this region to the south of Rome before and had never succeeded in doing so, Meijer was convinced that with his superior skills he would finally succeed. Already around 1680 and later in the 1690s, he drew up several contracts with wealthy Roman nobles and even dreamed of obtaining a noble title after having opened the land for cultivation. In the 1690s he indeed hired workmen to dig canals and build sluices in the marshes, but in the end the inhabitants of the surrounding villages and towns successfully obstructed these operations. They rightfully feared that they would lose the opportunity to acquire some additional income by fishing in the marshes and by herding some of their livestock in the drier sections of the plain. So by the time of his death, in 1701, Meijer had still not succeeded in draining even a small part of the marshes, and in his last will

he handed over this task to his son Otto. Otto Meijer bravely continued the work, but after a few more years he too had to acknowledge defeat.

CONCLUSION

As Hoogewerff saw it, the career of Cornelis Meijer foundered on the jealousy of the Italians. Notwithstanding the success of his *passonata* near the Via Flaminia and the willingness of some amateurs of science to admit him to the Accademia Fisicomatematica, he ended up impoverished and disillusioned. His books, however, remain an important source for the history of science and technology in Rome in the second half of the seventeenth century. They contain information about the Accademia Fisicomatematica that cannot be found anywhere else. In combination with his *Apologia* these books also inform us about the social conventions regarding the practice of science and technology in the age of baroque. And finally they draw our attention to the visual aspect of science and technology. What Meijer had to say on the course of comets or the effects of air pressure or the existence of the void is not very important perhaps, but the way in which he presented his conclusions does indeed merit our attention. As I suggested, in his representation of science Meijer is still very much indebted to the customs and conventions of the class of commercially operating engineers in Holland to which he originally belonged. Yet this was exactly what the new scientific elite in Rome needed in order to present their research in a trustworthy way to the learned world. Meijer and the Accademia made a perfect fit. A closer study not only of the texts, but also of the engravings these texts pretend to explain, as well as further investigations into the contacts Meijer had both with artists and with other engineers in Holland and in Rome might eventually shed more light on the development of the visual language of the new experimental natural philosophy.

Notes

1. A recent discussion of the importance of visual language in propagating the new experimental philosophy, especially the eclectic philosophy of the Leiden professor Arnold Senguerd, can be found in Gerhard B. Wiesenfeldt, *Leerer Raum in Minervas Haus. Experimentelle Naturlehre an der Universität Leiden, 1675–1715* (Amsterdam: Edita, 2001).

2. G. J. Hoogewerff, "Cornelis Jansz. Meijer, Amsterdamsch ingenieur in Italië (1620–1701)," *Oud-Holland* 38 (1920): 83–103. This article is mainly based on Roman sources, including Meijer's writings.

3. Giuliano Briganti, *Caspar van Wittel e l'origine della veduta settecentessa* (Rome: Bozzi, 1966); An Zwollo, *Hollandse en Vlaamse vedute-schilders te Rome, 1675–1725* (Assen: Van Gor-

cum, 1973), 120ff.; Giuliano Briganti, *Caspar van Wittel.* Nuova edizione a cura di Laura Laureati e Ludovico Trezzani (Milan: Electa, 1996).

4. Ellinoor Bergvelt and Renée Kistemaker, eds., *De wereld binnen handbereik. Nederlandse kunst- en rariteitenverzamelingen, 1585–1735* (Zwolle: Waanders, 1992) 51, 249–250, 324.

5. The Dutch text reads: *Verscheyde aanwijzingen en bequame middelen, aan d'Hartogh van Venetien & om alderhande Schepen, heen en weer, over rivieren en ondiepten te halen.* A copy is to be found in the Venetian Archives. See note 6.

6. Roberto Berveglieri, "Tecnologia idraulica olandese in Italia nel secolo XVII: Cornelis Janszoon Meijer a Venezia (gennaio-aprile 1675)," *Studi Veneziani*, N.S., 10 (1985): 81–91 (with illustrations); Idem, *Inventori stranieri a Venezia (1474-1788). Importazione de tecnologia e circolazione di tecnici, artigiani, inventori* (Venice: Istituto Veneto di Scienze, Lettere ed Arti, 1995), 152–166.

7. Much has already been written on this subject. See for instance: Cesare d'Onofrio, *Il Tevere e Roma* (Rome: Bozzi, 1970), esp. 80–85; Paola C. Scavizzi, *Navigazione e regolazione fluviale nello Stato della Chiesa fra XVI e XVIII secolo (il caso Tevere)* (Roma: , 1991).

8. Roman correspondents of Leibniz, like Christian Albert Walter and Ehrenfried Walther von Tschirnhaus, repeatedly informed the German philosopher and scientist of the Dutchman and his *passonata*—strikingly without ever mentioning his name. Walter simply referred to "un habile Hollandois" (a competent Dutchman), while Tschirnhaus, whose report is quite detailed, talks about "Hollandus." G. W. Leibniz, *Sämtliche Schriften und Briefe*. Dritter Reihe, Zweiter Band (Berlin: Akademie Verlag, 1987) 33, 317, 383–384. (I kindly thank Liesbeth de Wreede for drawing my attention to these letters.)

9. Versions of the report are to be found in the Biblioteca Corsiniana and the Biblioteca Nazionale in Rome and in the Staatsbibliothek in Münich. They all are densely illustrated and offer a wealth of material for comparing Meijer's and Van Wittel's contributions to the final report.

10. The copy of Meijer's booklet in the Vatican Library is titled *L'arte di restituire a Roma la tralasciata navigatione del suo Tevere* (Rome: Varese, 1679), but this is only added in handwriting. The copy in the University Library at Amsterdam does not have this title, and it is probable that the title is just a mistake. In the *Giornale de' Letterati* of 1680 there is a review of a book by Meijer that bears the title *Delinationi con discorsi delle Reparationi del Tevere fatte da Cornelio Meyer Olandese con alcuni pensieri circa la disseccationi delle Paludi Pontine, e fare un nuove alveo al Fiume* (Rome: Lupari, 1679), and this is exactly what the book is about. (The review also gives the correct printer.)

11. *L'arte di restituire à Roma la tralasciata navigatione del suo Tevere, divisa in tre parti. 1. Gl'impedimenti, che sono nell'alveo del Tevere da Roma à Perugia, e suoi remedii. 2. Le difficoltà, che sono nella navigazione del Tevere da Roma fino al mare, e suoi remedii. 3. Nel quale si discorre perche Roma è stato fabricata, e mantenuta sù le sponde del Tevere, e si tratta d'alcun' altre propositioni proficue per lo stato ecclesiatico.* Dell' ingegniero Cornelio Meijer (Rome: Stamperia della Reverenda Camera Apostolica, 1683).

12. Not everybody was convinced that the *passonata* would hold. In April 1678 Von Tschirnhaus wrote to Leibniz: "Satis bene successit, sed cum non tam bene atque tam alte in nostris regionibus extructum videatur, nescio an sit futurum durabile." Leibniz, *Sämtliche Schriften und Briefe* 3.2, 389. This clearly is an echo of Fontana's (unfounded) criticism.

13. There is one engraving drawn by Caspar van Wittel and a few by other artists.

14. *Dizionario Biografico degli Italiani* 25 (1981): 136–143.

15. According to the entry in the *Dizionario Biografico degli Italiani* 43 (1993): 273, Eschinardi "fosse in qualche modo il principale animatore."

16. On the Accademia: W. E. Knowles Middleton, "Science in Rome, 1675–1700, and the Accademia Fisicomatematica of Giovanni Giustino Ciampini," *British Journal for the History of Science* 8 (1975): 138–154. Since the author was interested mainly in the history of the thermometer, his account of the activities of the Accademia is rather one-sided. More information

is offered by Salvatore Rotta, "L'accademia fisicomatematica Ciampiniana: un' iniziativa di Cristina?," in W. di Palma a.o., *Cristina di Svezia. Scienza ed alchimia nella Roma barocca* (Bari: Dedalo 1990), 99–186. As the title of the article already suggests, Christina of Sweden had nothing to do with the Accademia. Ciampini and others may have hoped to place their society under the protection of the former queen of Sweden, but she did not have the financial means to do so. On the *Giornale*: Jean-Michel Gardair, *Le 'Giornale de' letterati' di Roma (1668–1681)* (Firenze: L. Olschki, 1984), esp. ch. 7.

17. When Marcantonio Celli, fellow of the Accademia, wrote a letter to Cassini, informing him about what was going on in Rome, he also mentioned Meijer and introduced him as the man who had constructed the *passonata* and thereby had saved the Strada Flaminia.

18. There is for instance a reference to Bartholomeus Schimpffer, *Kurze Beschreibung des dunckelen Cometen so anno 1652 den 8. Decembr erschienen darauff gemeiniglich sonderliche Enderungen und Verwirrungen zuerfolgen pflegen* (Frankfurt am Main: Johann Phillips Weiss, 1653). Schimpffer, an obscure almanac maker and astrologer in Halle (Saxony), predicted that the comet would reappear in 1682 and since around that time indeed a new comet was seen (the comet of Halley), on Meijer's suggestion the members of the Accademia ordered the book from some library in Rome (nowadays it is very rare), had someone translate it, and then discussed its contents.

19. *Nuovi ritrovamenti dati in luce dall' ingegniero Cornelio Meyer per eccitare l'ingegno de' Virtuosi ad augmentarli ò aggiungervi maggior perfettione* (Rome, 1689). Among the topics discussed by Meijer in this book we find eyeglasses, couches, the furnishing of a cabinet of curiosities—including a chemical laboratory—the introduction of silkworm breeding in Italy, and even some medecine. In the context of the treatment of illnesses caused by the little animals seen through the microscope Meijer claims to have been present at some of the anatomical dissections of Jan Swammerdam (who died in 1680), which once again indicates that Meijer's interest in science dates back to his early life in Holland. Also included is a chapter in which Meijer cites a number of biblical texts on the correct payment of businessmen ('Tenor Sacrae Scripturae de Mercede')!

20. In 1694, the year in which his magnum opus on St. Peter's Church was published (*Il tempio Vaticano e la sua Origine*, in Italian and Latin), Fontana also had the time to issue a *Discorso sopra le cause delle inondazioni del Tevere antiche e moderne à danno della città di Roma, e dell' insussistente passonata fatta avanti la Villa di Papa Giulio III per riparo della via Flaminia* (reissued in 1696). See Helmut Hager, "Le opere letterarie di Carlo Fontana come autorappresentazione," in *In Urbe Architectus. Modelli, disegni, misure. La professione dell' architetto, Roma 1680–1750*, Ed. Bruno Contardi, Giovanna Curcio, (Rome: Argos, 1991), esp. 177–187.

21. The full title runs *Apologia di Francesco Maria Onorati per la passonata fatta sopra il Tevere fuori di Porta del Popolo in difesa della Strada Flaminiana con le direttione del Signor Cornelio Meyer, famoso ingegniere olandese all'eminentissimo e reverendissimo prencipe il Sig. Cardinale Gio. Francesco Albano Segretario de Brevi di nostro signore*. In Roma MDCXCVIII. In the foreword Onorati confesses to be the mouthpiece of Meijer himself, "havendo io quì quasi la sola parte di traduttore & interprete del suo linguaggio." This foreword also contains a direct reference to the Dutch as being such able hydraulic engineers: the *passonata* was built "secondo i suoi principii di far Passonate all'usanza Olandese, che in quelle parti sostengono con artificio incomparabile sopra il dorso della passonata il peso di tutte le acque di quel gran Mare che bagna l'Olanda." Onorati in his capacity of "ministro deputato per la Reverenda Camera" had been the papal supervisor during Meijer's construction of the *passonata*, which means that he had a vested interest in clearing Meijer of all charges brought against him by Fontana.

22. Meijer's efforts are relatively well documented by Hoogewerff, "Cornelis Janszoon Meijer," and J. Korthals Altes, *Polderland in Italië. De werkzaamheden der Nederlandsche bedijkers in vroeger eeuwen en het Italiaansche polderland voorheen en thans* (The Hague: Van Stockum, 1928).

Part 3

CONSUMPTION, ART, AND SCIENCE

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Inventing Nature

Commerce, Art, and Science in the Early Modern Cabinet of Curiosities

PAULA FINDLEN

"But is it a basilisk?"

"It's a saltwater fish that charlatans usually arrange in the form of a basilisk, and it helps them deal with peasants in the piazza when they want to sell their balsam."

—Carlo Goldoni, *Famiglia dell'antiquario*

CURIOSITIES FOR SALE

In 1653, a curious book appeared in the city of Venice: Niccolò Serpetro's *Marketplace of Natural Marvels*. Serpetro's encyclopedia was one of many such volumes that satisfied the seemingly infinite desire for wonders in the early modern period. It followed a rich publishing history of broadsheets, natural histories, and encyclopedias of the strange and unfamiliar that characterized the sixteenth-century love affair with the marvelous, and that cataloged the many pleasurable and terrifying ways in which nature made manifest the hand of God in the world.[1] Serpetro drew liberally from this tradition to create his own theater of wonders. But he added one innovation that was entirely his own: he placed his marvels in the marketplace, a teeming piazza in which merchants and customers bargained over goods for sale, and wares were displayed for all to see (fig. 12.1). It was the most fitting location that he could imagine for the pursuit of wonder.

It is surely appropriate that a book published in the city of Venice—still a thriving center for trade and commerce despite the challenges of such northern cities as Amsterdam, Marseilles, and London, and the Spanish gateway to the Atlantic, Seville—should imagine the world of marvels to be a marketplace. Serpetro explained his metaphor as follows: "Since in a

Figure 12.1 Charlatans selling their wares in Piazza San Marco, Venice. Source: G. Franco, *Habiti d'huomini e donne* (Venice, 1609). Courtesy of Marquand Library of Art and Archaelogy, Princeton University Library.

famous marketplace the wealthiest merchants come from many different countries to show gems and the most precious and admirable things that one finds in various provinces of the world, thus, in this work I tried to transport from the most celebrated authors the rarest and most delightful marvels that the Author of Nature has produced." He made his book a literal marketplace, dividing it into porticos, loggias, and shops so that passersby could "walk easily" among them.[2] Each chapter was an imagined purchase, or at the very least a bit of window shopping in the marketplace of marvels. Serpetro had probably taken the idea of the marketplace from works such as Tommaso Garzoni's *Universal Piazza* (1585), a popular encyclopedia that collected all the professions of the world into an imaginary piazza.[3] But he was also an astute observer of his times. Nature was for sale in many marketplaces throughout Europe. It was a commodity bought, sold, bartered, and exchanged—the centerpiece of a series of transactions that connected the world of commerce to the study of nature.

Shopping for natural curiosities was indeed possible by the time Serpetro wrote his *Marketplace of Natural Marvels*. We need only think of the Dutch tulip craze at the beginning of the seventeenth century to recall just how frenzied the market for a particular curiosity could become.[4] More generally, however, the growing popularity of cabinets of curiosities—private, princely, and, in a few cases, institutional collections that grew in size and scope throughout the early modern period—gradually transformed the act of collecting nature into a business. It produced a world of entrepreneurs who saw nature in new ways because of the culture of collecting. In February 1644, John Evelyn described the experience of walking through the merchants' stalls in the Isle du Palais in Paris. One shop, in particular, caught his attention, a place called Noah's Ark. There "are sold all curiosities naturall or artificial, Indian or European, for luxury or use, as cabinets, shells, ivory, porselan, dried fishes, insects, birds, pictures, and a thousand exotic extravagances."[5] Evelyn had found a cabinet of curiosities in which everything was for sale. Collectors missing some choice item for their cabinets could depend upon the proprietor of Noah's Ark to supply them with a sample—for the right price.

The idea of a shop filled with curiosities seemingly contradicted the humanist ideal of scientific collecting as a series of exchanges among scholars in which objects were freely given as an act of friendship; they accompanied and embellished the words that described them.[6] Many collectors accumulated the majority of their artifacts through travel and through the generosity of other scholars with whom they regularly exchanged letters, images, and specimens. But it was also possible to buy a cabinet of curiosities, or at least its most important parts, by the early seventeenth century. Such purchases were costly luxuries—not an act of scholarly inquiry into nature but a sign that the pleasures of collecting involved more than the single-

minded pursuit of knowledge. If having a collection was one means by which a prince or a merchant might proclaim his ability to command the world, creating a microcosm in which to receive visitors and to demonstrate his place in a world of global commerce and conquest, then a collection was indeed worth something. Many objects did have a precise monetary value, even if scholarly collectors chose to ignore this aspect of the passion for curiosities.

The market for marvels produced more than one type of collector, and all of them in different ways responded to the exigencies of the marketplace. In addition to thinking about learned naturalists such as Ulisse Aldrovandi, who created a theater of nature in late sixteenth-century Bologna in order to know more about the natural world, we need to consider a different kind of collector who understood the idea of profiting from wonder. The early seventeenth-century Augsburg merchant Philipp Hainhofer, for example, not only acted as purchasing agent for rulers who sought out luxury goods, but explicitly made his cabinets of curiosities, filled with objects acquired from merchants at the Frankfurt fairs, to sell them. He speculated in nature. "When someone presents me with a foreign object for my *Kunstkammer*," he once said, "I experience more pleasure than if he had given me cash."[7] This comment that reflects the ways in which curiosity and commerce worked harmoniously together. Curiosities, after all, might be a good investment in terms of the favors and ultimately business they might bring from certain patrons.

Hainhofer was perhaps one of the earliest collectors, following in the wake of the Fugger merchants who had acquired many objects for princely patrons, to recognize that the value of the cabinet of curiosities was not simply intrinsic. By the late seventeenth century, tales of the fantastic sums that princes were willing to pay for a good cabinet circulated among connoisseurs of such things. The grand duke of Tuscany's efforts to acquire the Dutch naturalist Jan Swammerdam's collection of insects—and his expertise as a naturalist—for 12,000 guilders were well-known and only increased the status of this particular collection.[8] Around the same time, the duke of Modena became so fascinated with Manfredo Settala's gallery of curiosities and inventions in Milan that he attempted to purchase it. Negotiations had fallen apart by the early 1660s, but when John Ray and Philip Skippon visited the newly installed cabinet in the ducal palace in February 1664, visitors were still being told of the outrageous sums the duke had been willing to pay for a collection he never succeeded in buying.[9] The economic ability to *afford* a famous cabinet, in other words, had become a measure of one's status.

By the eighteenth century, natural history cabinets were put up for public auction, and sale catalogs began to appear with greater regularity, reflecting a full-scale commercialization of collecting culture. In the late sixteenth and seventeenth centuries, however, it was rare to have an entire cabinet made purely for profit. Individual objects might be heavily embedded in the world

of the marketplace, and occasionally princes might try to buy a collection, but the majority of cabinets emerged from an individual collector's passion for things. Yet even these collectors, however removed from the world of commerce, had to contend with the ways in which their fascination with nature was fueled by a variety of individuals who had unique access to natural objects and understood the profitability of nature. No collector could entirely remove himself from the marketplace. How they interacted with it reveals a series of interesting connections between commerce, science, and art.

TRAFFICKING IN NATURE

Early modern natural history was a product of the new material abundance that flowed into European cities from all corners of the world. It extended the medieval culture of buying and selling nature into new domains because knowledge quite literally grew in proportion to the expansion of European trade.[10] While humanists who studied nature for the pure pleasure of extracting knowledge might scoff at those who used their knowledge to turn a profit, the fact remains that nature had always been a commodity to the rest of the world. Since the Middle Ages the spice trade between western Europe and the Levant– dried bits of nature that traveled thousands of miles to satisfy the taste for the exotic—had shaped the commercial image of nature. Columbus's attentiveness to the wonders of the New World in 1492 was hardly disinterested curiosity. He was not simply looking for the monsters described in Pliny's *Natural History*, but also went in search of nature for profit—cinnamon, balsam, aromatic woods, and unusual animals and plants to delight the palate as well as the eye, and to cure the diseases of the Old World with the nature of the New.[11]

The profitability of nature was closely tied to its medicinal uses. Nature provided the ingredients for a vast array of medicines in the ancient pharmacopeia, from simple herbal remedies to more highly prized items such as balsam, bezoar stones, and all of the key ingredients to create that panacea of panaceas, theriac.[12] Merchants, apothecaries, and physicians together created an economy of natural objects. They bought those parts of nature that they could not cultivate and acquire on their own and transformed them into medicines. The rarest and most exotic medicines, dependent on ingredients from the Levant and later the New World, were usually composed of costly ingredients. Serpetro's image of marvels lined up under the porticos for sale was not at all improbable: it reflected the reality of the most marvelous aspects of medicine.

If commerce and medicine established the essential contours of trafficking in nature, faith placed a high premium on a different set of unusual

objects. By the thirteenth century the Crusades had created a lively trade in relics, but also in natural objects that conformed to ancient accounts of the marvels of the East.[13] The spoils of Christian conquest included a kind of mythologized conquest of nature: Egyptian crocodiles, ostrich eggs, alleged unicorn's horns, griffin's claws, and other examples of exotic nature, real and imagined, began to appear in churches and treasuries throughout western Europe.[14] While not as highly prized as sanctified relics, such objects reflected a growing interest in the fantastic parts of nature described in medieval bestiaries and other Christian allegories of nature that privileged certain animals as harbingers of God's will. The basilisks, griffins, and dragons found in the Bible and in such works as Pliny's *Natural History* became more than paper fantasies of natural omens. Increasingly, they were actual objects created to satisfy the taste for such curiosities. Such objects did not disappear at the end of the Middle Ages but enjoyed a certain revival in the age of the Reformation. In an era fascinated with reports of omens and prodigies that signified God's will in a world of divided faith, they were fully integrated into the cabinets of curiosities.

In all of these different ways, curiosity about the natural world shaped the marketplace of marvels. The fascination with wonder helped to create a kind of individual skilled in buying, selling, and creating wonder. Curiosity created its own commerce—a world of specialists in natural curiosities that we can only glimpse indirectly through accounts of nature in the early modern period. Such individuals did not aspire to interpret nature, but to sell nature to those who created knowledge out of the raw ingredients of the marketplace. Extraordinary things demanded a special expertise to acquire and invent them, which gave them economic as well as symbolic value. Understanding more precisely how learned collectors acquired the wonders that they prized brings us into closer contact with the marketplace that they were often loathe to discuss. It was a world filled with mountebanks and charlatans who cultivated ties with physicians, apothecaries, and merchants in order to sell their vision of nature to a public consumed by curiosities.

The tensions between those who sold nature and those who interpreted it are evident in letters that accompanied objects in circulation among naturalists. When a learned collector crossed the imagined boundary between science and commerce, he was subject to scathing criticism. In the 1590s, for example, naturalists complained to each other about the practices of the Basel physician Felix Platter who, according to one source, refused to make gifts of his curiosities, selling "everything he has."[15] This rather unusual comment about a learned naturalist suggests that by the end of the sixteenth century the line between science and commerce was increasingly blurred, if it had ever been clear. Buying nature in the marketplace was a commonly accepted practice among naturalists, a necessity to increase and replenish the

storehouse of knowledge. Selling nature, however, was an activity unworthy of a natural philosopher. Or was it? Platter's decision to sell what he possessed suggests that it had become possible to put a price on the time and expertise required to find and cultivate something rare, even for the purposes of study.

Selling curiosities in a cabinet, or selling an entire cabinet, represents the final step in a series of transactions that began the moment a curiosity became available. Following an object from the beginning to the end helps us to understand more precisely how science and commerce intersected. Let us take the case of a curiosity that entered Ulisse Aldrovandi's collection in Bologna in 1579, a gift of one of his regular correspondents, the Genoese patrician Bernardo Castelletti. Castelletti exemplified well the meaning of friendship in late Renaissance natural history. He routinely procured new curiosities for Aldrovandi to describe in his great, unpublished natural history, and asked nothing in return but the pleasure of corresponding with a famous naturalist. The gifts he gave to Aldrovandi arrived in his hands by many different avenues, and included curiosities he purchased in the public piazzas of his city. In February 1579, Castelletti sent a letter announcing the imminent arrival in Bologna of the most marvelous fish he had ever seen: "What's more, you will have a fish that is one of the rarest and most extravagant parts of nature in the sea." He described how he acquired this rather ugly fish with bulging eyes:

> It was given to me dried, as I send it to you, by the fisherman who caught it, who, upon seeing it had such strange features, didn't throw it back into the sea, as fishermen usually do with all the other useless fish. Indeed he kept it alive as long as he could, and then had it dried to show to people as a miraculous thing.[16]

The ingredients in the story are the stuff of which cabinets of curiosities were made and replenished: a useless fish, an ambitious fisherman, an audience eager to pay to see natural oddities, and collectors who could not resist acquiring them. This was quite literally the experience of nature in the marketplace.

The dried monster made its way to Bologna and Aldrovandi added it to his museum. He may have even had his artists illustrate it and dictated a description to his scribes, in preparation for its inclusion in his *Natural History*.[17] This at least was Castelletti's fear a few years later. Apologetically and quite reluctantly, he informed Aldrovandi that the marvel had been invented by the fisherman who sold it to him. "I am sorry to have to tell you that in the description of the fish sent to you some years ago, I was deceived. . . ." Worried that he had compromised the veracity of Aldrovandi's account of

nature, he confessed that his words as much as the object itself were not a reliable source of information. They, too, had been bought and sold in the marketplace: "they are those that the fisherman sold me."[18] A clever vendor of the nature's bounty had tricked a gullible humanist into believing that all the monsters found in Pliny's *Natural History* truly might be acquired for one's museum, if only one looked hard enough. Castelletti had forgotten the golden rule: *caveat emptor*.

Such episodes give us further insight into the way in which the commerce in natural curiosities responded directly to the collector's passion for the exotic and unknown. A city like Genoa was a trading zone for natural curiosities. When the grand duke of Tuscany commissioned his botanist at the University of Pisa, Francesco Malocchi, to acquire curiosities for the university garden and its museum during the summer of 1599, Malocchi planned an itinerary that made Genoa his final destination. Malocchi's buying trips were, in essence, a merchant's itinerary to the port cities of Italy. In each city, he encountered men who had curiosities to sell, and made purchases for the grand duke which were recorded in his ledger. In April 1604, for instance, Malocchi acquired an entire "whale skeleton"—a rare prize for an early modern natural history museum—in the port city of Livorno.[19] He was more successful than the French royal surgeon Ambroise Paré, who was fascinated by "a head of a large fish in the house of a rich merchant" in Lyon that he hoped to acquire for King Charles IX.[20] Unfortunately the fish was quarantined with the family during a plague epidemic, and that was the last Paré ever saw of it. These and other anecdotes suggest that naturalists routinely visited merchants who owned and sold curious things.

Knowledge of nature could not increase without the commerce in nature. Naturalists had to come to terms with the marketplace in order to pursue curiosities. Digging further into Aldrovandi's correspondence we find indications that he knew some of the famous charlatans of his day who made and sold curiosities in the piazza, and considered them an interesting source of knowledge as well as artifacts. In April 1568, for example, a correspondent from Piacenza described their mutual acquaintance "Master Leone who sells his wares in public often, and is known to all the apothecaries in Venice."[21] Leone Tartaglini of Foiano was a famous mountebank known to most collectors of natural curiosities in late sixteenth-century Italy. He inhabited the Venetian piazza famously depicted as filled with men of his profession. Naturalists traveled from cities as dispersed as Lucca, Piacenza, Bologna, and Verona to see his cabinet of curiosities in Venice, which was an early precursor to the Parisian Noah's Ark that Evelyn described. Many of the objects Tartaglini possessed were evidently for sale. Among other things, he specialized in the sort of extravagant fish that Castelletti admired and purchased in Genoa. Visitors to Venice reported that he had a book illustrating

all of his dried fish—a book Aldrovandi, among others, wanted very much to see.[22] While many naturalists collected images of curiosities in order to create a complete archive of the natural world, in Tartaglini's case, such a book might have served the additional purpose of advertising the kind of nature that he sold.

The image of the seller of nature as a mountebank appears not only in descriptions of Tartaglini's activities in Venice, perhaps the most famous vendor of curiosities of whom we have a precise description, but also informed other accounts of the buying and selling of curiosities. In November 1663, the English traveler Philip Skippon encountered a mountebank named Rosachio, an astrologer who sold medicines in Piazza San Marco. Skippon was evidently fascinated by Rosachio; he followed his initial encounter with the mountebank by visiting Rosachio at home in order to see his "collection of rarities." In it was a flying serpent—or at least an alleged flying serpent since Skippon described it as having "a long furrow on either side, in which were cartilaginous parts (he said) when it was alive, that served for wings."[23] Skippon's traveling companion, the great English naturalist John Ray, evidently did not find the alleged dragon worthy of note since he neglected to include it in his own journal of the same voyage, but the fact remains that a century after Tartaglini had succeeded in getting all the great naturalists of Italy (and undoubtedly other regions) to visit his cabinet in Venice, mountebanks were still selling the same bits of artificial nature to the heirs of Aldrovandi. In the 1672 catalog to his museum in Verona, Count Lodovico Moscardo continued to discuss the "swindlers and charlatans from Dalmatia" who sold examples of the basilisk in his museum.[24]

The network of people who bought and sold nature was composed of more than just charlatans and random fishermen who showed exotic fish in the fish markets. Let us return for a moment to the fact that Master Leone of Venice was known to all the apothecaries of the city. Were they as much the source of his curiosities as he was of theirs? In his *History of Animals* (1558), the Swiss naturalist Conrad Gessner informed his readers about "apothecaries and others who usually dry rays and shape their skeletons into varied and wonderful forms for the ignorant."[25] Rather than condemning charlatans, Gessner blamed apothecaries for facilitating this trade, indeed accused them of inventing fraudulent curiosities. We can find traces of relationships among apothecaries and mountebanks in surviving correspondence. The Veronese apothecary Francesco Calzolari, for instance, was so intrigued by reports of Master Leone's activities that he sought out the artist who had illustrated the Venetian's curiosities.[26]

Scholarly collectors recognized that the pharmacy was both a world of wonder and an extension of the marketplace. They entered it expecting to find an invented nature (fig. 12.2). Visiting apothecaries was an important

Figure 12.2 The apothecary Francesco Calzolari's museum in Verona, filled with many strange fish and reptiles hung from the ceiling. Source: Benedetto Ceruti and Andrea Chiocco, *Musaeum Franc[isci] Calceolarii Iun[ioris]. Veronensis* (Verona, 1622). Courtesy of the Biblioteca, Universitania, Bologna.

part of the collector's itinerary. John Ray took pleasure in "a so-called siren's rib" in the apothecary Jean van der Mere's collection in Delft and visited the apothecary Mario Salò in Verona, who claimed to have the "reliques of *Calceolarius* his *Museum*."[27] Possibly one of the items surviving from Calzolari's museum that did not especially impress Ray in 1663 was the unicorn's horn that Aldrovandi saw when he visited his shop at the Sign of the Golden Bell in Piazza dell'Erbe in 1571. Aldrovandi was too polite to tell Calzolari that it was a fake, but he privately noted "that there is no doubt that it is not a true example."[28] Such objects were also the ordinary stuff of any cabinet of curiosities. But apothecaries, who practiced a certain alchemy on nature to create their medicines, must have seen the fabrication of natural objects as a

demonstration of professional skill—the ability to manipulate nature. They filled their shops with those marvels, real and imaginary, that helped to sell their medicines and reminded people of the apothecary's close connections with the world of art to which they were officially joined in towns where painters and apothecaries belonged to the same guild because both transformed the raw ingredients of nature into art.[29]

Collectors understood that the more unusual nature *seemed* to be, the more likely it was a product of their own demand for a certain kind of wonder. They repeatedly offered advice on how to discern the difference between an authentic and fabricated version of nature. The Milanese physician Girolamo Cardano advised his readers to inspect the joints and sutures of marvelous creations in order to see if they had been put together by human rather than divine hands.[30] But the possibility of fraud did not make collectors any less interested in acquiring them—quite the opposite since invented bits of nature were highly prized. One of the less well-studied aspects of the cabinets of curiosities regards the significance of objects that purported to be natural while actually being artificial. These fabrications allow us to understand how commerce and science helped to create the art of nature in the early modern period.

INVENTING THE HYDRA AND THE BASILISK

The most popular fabrications of the sixteenth and seventeenth centuries were hydras and basilisks. They took their place in the cabinet of curiosities among the many different kinds of dragons that fascinated early modern collectors. Flying dragons, eagle-fish, and other hybrids of the imagination emerged from the pages of medieval bestiaries and church and princely treasuries to fill Renaissance museums. They did so according to rules of art that were best expressed in a passage from Leonardo da Vinci's notebooks. Describing how to make an imaginary animal appear natural, Leonardo wrote:

> You know that you cannot make any animal without it having its limbs such that each bears some resemblance to that of some one of the other animals. If therefore you wish to make one of your imaginary animals appear natural—let us suppose it to be a dragon—take for its head that of a mastiff or setter, for its eyes those of a cat, for its ears those of a porcupine, for its nose that of a greyhound, with the eyebrows of a lion, the temples of an old cock and the neck of a water-tortoise.[31]

The rules of good painting applied no less to the three-dimensional construction of an imaginary animal. In order to be convincing, it had to origi-

nate in nature. Leonardo's contemporary Albrecht Dürer also believed that art emerged from nature, and he strove hard to give the beasts of the Apocalypse a more anatomical appearance.[32] Leonardo's example of a dragon was hardly casual because it was indeed the imaginary animal of choice. It was the most fantastic and symbolically potent animal in the Christian imagination, worthy of multiple inventions across the centuries.

The hydra and the basilisk—two of the most elaborate kinds of dragons described in ancient and biblical sources—had a level of complexity that many other natural inventions did not. A unicorn's horn was the horn of a narwhal. A griffin's claw was often a bison's or ox's horn. Many inventions of nature, in other words, were entirely natural. They simply involved an act of reinterpretation in order to see the imaginary in the real. Objects that took shape through the manipulation and transformation of nature belonged to an entirely different category. They were truly works of art in which one could take pleasure in the possibilities that nature suggested to the human mind.

Not coincidentally, they were also objects on which one could put a price—repositories of economic as well as spiritual capital.[33] Conrad Gessner described a hydra that had been brought from Turkey to Venice in 1530 and acquired by the king of France (fig. 12.3). "It is appraised at six thousand ducats," he wrote in 1560. Like Dürer's rhinoceros, Gessner's hydra was an image derived from an image. He lifted it from broadsheets such as Dürer's popular *Whore of Babylon* (1498) that depicted the seven-headed beast of the Apocalypse with vivid clarity for a public eager to see signs of a world in turmoil. An encyclopedia such as Conrad Lycosthenes's, *Chronicle of Prodigies and Portents* (1557) was probably the more direct source for Gessner's illustration. Evading the issue of its truth or falsehood, Gessner chose instead to comment on the hydra's art. "The ears, tongue, nose, and faces are different from the nature of all species of serpents. But if the author of such an invented natural thing were not ignorant, he would be able, with great artifice, to trick observers."[34]

Aldrovandi agreed with Gessner's assessment of the hydra. After receiving a hydra from a Ferrarese noble who wanted to know if it was authentic, Aldrovandi responded that, given the confused description of the hydra among the ancients—an animal with three, four, seven, nine, or even ninety heads—it was hardly surprising that no one knew the truth about it. He reflected on how others had profited from this uncertainty: "it is no wonder that in our age some have been deceived by the miraculous artifice with which these hydras are faked from other bodies and put together, as they have also done with the flying dragon—which however does exist in nature—trying to imitate it by using a species of marine ray, as one can see in my study." His assessment of the hydra of Ferrara was mixed. The body

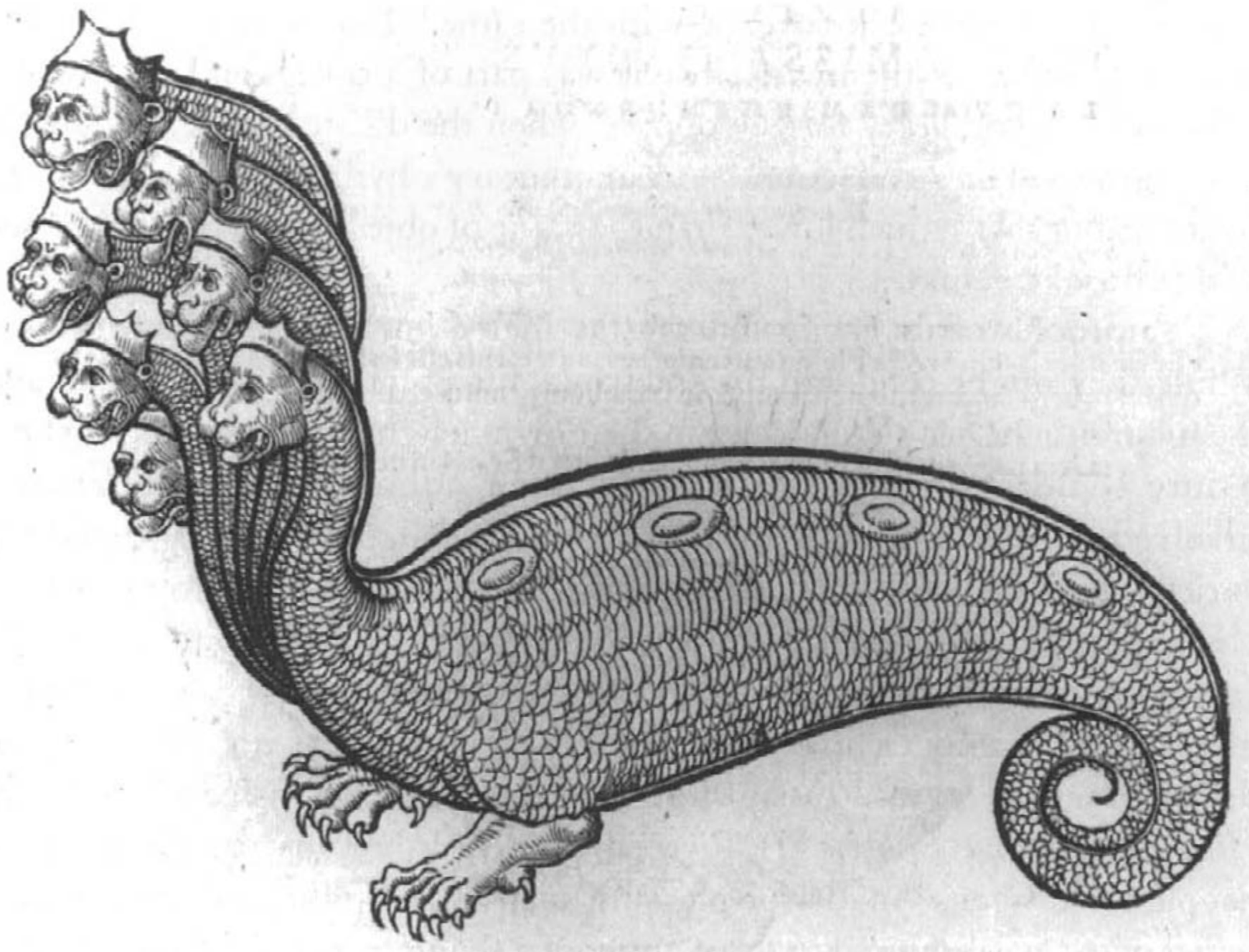

Figure 12.3 The King of France's many-headed hydra, valued at 6,000 ducats in 1560. Source: Conrad Gessner, *Nomenclator aquatilium animantium. Icones animalium* (Tiguri, 1560). Courtesy of Department of Special Collections, Stanford University Libraries.

and tail came from the "true flying dragon that is born in Arabia and Egypt," but the heads had come from different animals and one could see that various parts of the dragon—its wings and its hind legs—had been removed to give it the appearance of a hydra.[35] It was a half-true specimen, a wonder of nature transformed into a work of art by the desire of nature's artisans to turn a profit. Better, in short, than the hydra of San Marco in Venice, which he declared to be patently false.[36] For this reason, Aldrovandi engraved it for eventual inclusion in his *History of Serpents and Dragons*.

Undoubtedly because hydras were often found in state treasuries—the Venetian doge had a fine example with nine heads, for instance[37]—visitors talked more self-consciously about their monetary worth (and went to famous naturalists such as Aldrovandi to see if they would authenticate them, which surely increased their value). Skippon, for instance, admired the seven-headed hydra in the duke of Modena's gallery, originally a gift of the Holy Roman Emperor Charles V to the Gonzaga family of Guastallo. He, too, refused to say with certainty that the hydra was a fake, though he commented on "the head being like that of fitchet, or of that kind, the body and feet were of a rabbet or hare, and the tail was made of common snake's

skin, the back and neck covered with the same." But he was very precise about the origins of the hydra since it was part of a collection bought from "*Zennon* the apothecary for 300 doppii" when the d'Este family was unable to acquire Settala's collection.[38] An apothecary's hydra, of course, had its price—and it was much lower than the value of objects normally associated with a ducal treasury.

The process of inventing nature fascinated early modern naturalists. While they might condemn mountebanks for preying on the gullible and the ignorant, they could not contain their own delight in understanding how nature could be invented or suppress their admiration for the artistry involved in making monsters. As naturalists collected and inspected the variety of nature with greater regularity, they began to put into print their observations on nature's fabrications. Dragons were a focal point of this discussion and, more often than not, such discussions appeared in ichthyologies—further underscoring the idea that the point was not to talk about dragons *sui generis* but to discuss how to make them from fish. In his *Natural History of Strange Fish* (1551), Pierre Belon described the passion of many people for dragons "made for pleasure such as those that we see counterfeited with rays disguised in the manner of a flying serpent."[39] Conrad Gessner's complaint in 1558 about fraudulent apothecaries came in the midst of a lengthy discussion of dragon-making in his *History of Animals*. In a chapter on rays, he described in great detail how such monsters were made. "They bend the body, distort the head and mouth, and cut into and cut away other parts. They raise up the parts that remain and simulate wings, and invent other parts at will."[40] Understanding the possibilities of the ray as a dragon *in potentia* was the first step in appreciating the art of the dragon.

The ability of many naturalists to look critically at the anatomy of the hydra, the basilisk, and many other kinds of dragons reflected the shifting religious and intellectual climate. In the early decades of the sixteenth century, such creatures were sufficiently charged with religious meaning that it would have been heretical to suggest that they were anything less than God's will. By the 1550s, it had become possible to inspect these portents as examples of nature's variety and to suggest that human intervention made them approximate people's fantasies of a terrifying nature. Increasingly, such objects seemed to evoke pleasure more than horror.[41] The Renaissance dragon, after all, was usually no more than a couple of feet long. Cardano simply couldn't imagine how many of the specimens he saw could fly. J. C. Scaliger contented himself by observing: "The skin is like that of a ray."[42] One wanted to know *how* they were made while avoiding the question of whether they existed.

Naturalists actively collected and traded these physical talismans of the medieval and Reformation culture of portents—no longer clear demonstrations of the mysterious ways in which God's will manifested itself in the

world, but increasingly desirable items for cabinets of curiosities. In 1573, the French surgeon Ambroise Paré recalled a marine monster that Cardano sent Gessner, "which had a head similar to a bear and hands almost like a monkey, and the rest of a fish."[43] Such descriptions reveal the pleasure naturalists took in understanding how harmonizing the many parts of nature into something new and unexpected might be an art unto itself. Examining the griffin's claw in the treasury of Charles V, for instance, Cardano reflected: "perhaps by carving out an ox's horn, art invents nature."[44] The ability to dissect the bestiary that made the beast gave credence to the idea that knowledge did transform how one looked at an object. If commerce responded to curiosity by inventing what people wanted to see, then science responded to art by understanding that the boundaries between nature and art were there to be crossed. We need only think of the jeweled boxes that German and Italian artisans made in the shape of crocodiles and dragons, the French artisan Bernard Palissy's ceramic re-creations of nature, or the flying dragon chandelier that Dürer designed in Nuremberg, which used the natural shape of a stag's antlers for its wings, to recognize how the idea of making art from nature was a central theme of the late Renaissance.[45]

By the time Aldrovandi's *On Fish* appeared posthumously in 1613, it reflected the new sensibility of late Renaissance natural history toward the idea of inventing nature. While indebted to all previous publications that had discussed fabulous creatures in the cabinets of curiosities, Aldrovandi's book improved upon them by showing the artifice of inventing dragons and basilisks from rays in greater visual detail. His work included no less than two images of a "ray dried and shaped in the form of a dragon" as well as a "sea-eagle" that he declared to be patently false (fig 12.4).[46] Examining these images, we can see explicit efforts to demonstrate the artifice of the object in question while retaining the canonical form of the dragon.

Aldrovandi's images of flying dragons provided the introductory material for a chapter on the basilisk in Bartolomeo Ambrosini's edited version of Aldrovandi's *History of Serpents and Dragons* (1640). A small, solitary African dragon described by Pliny and Galen, it was reputedly so poisonous that it could kill someone with its breath or its glance, dry plants, and break stones in half.[47] It quickly became the canonical example of a work of nature transformed into a work of art (fig. 12.5). Aldrovandi reported that the great physician Girolamo Mercuriale had found a "basilisk's cadaver" in the treasury of the Holy Roman Emperor Maximilian II. He (or his editor Ambrosini) tactfully chose not to comment directly on the imperial basilisk, restricting himself instead to condemning those "imposters" who frequently made basilisks "out of small dried rays."[48]

Aldrovandi's comments on the invention of the basilisk rested on the more extensive critique of this animal composed by the imperial physician Pier

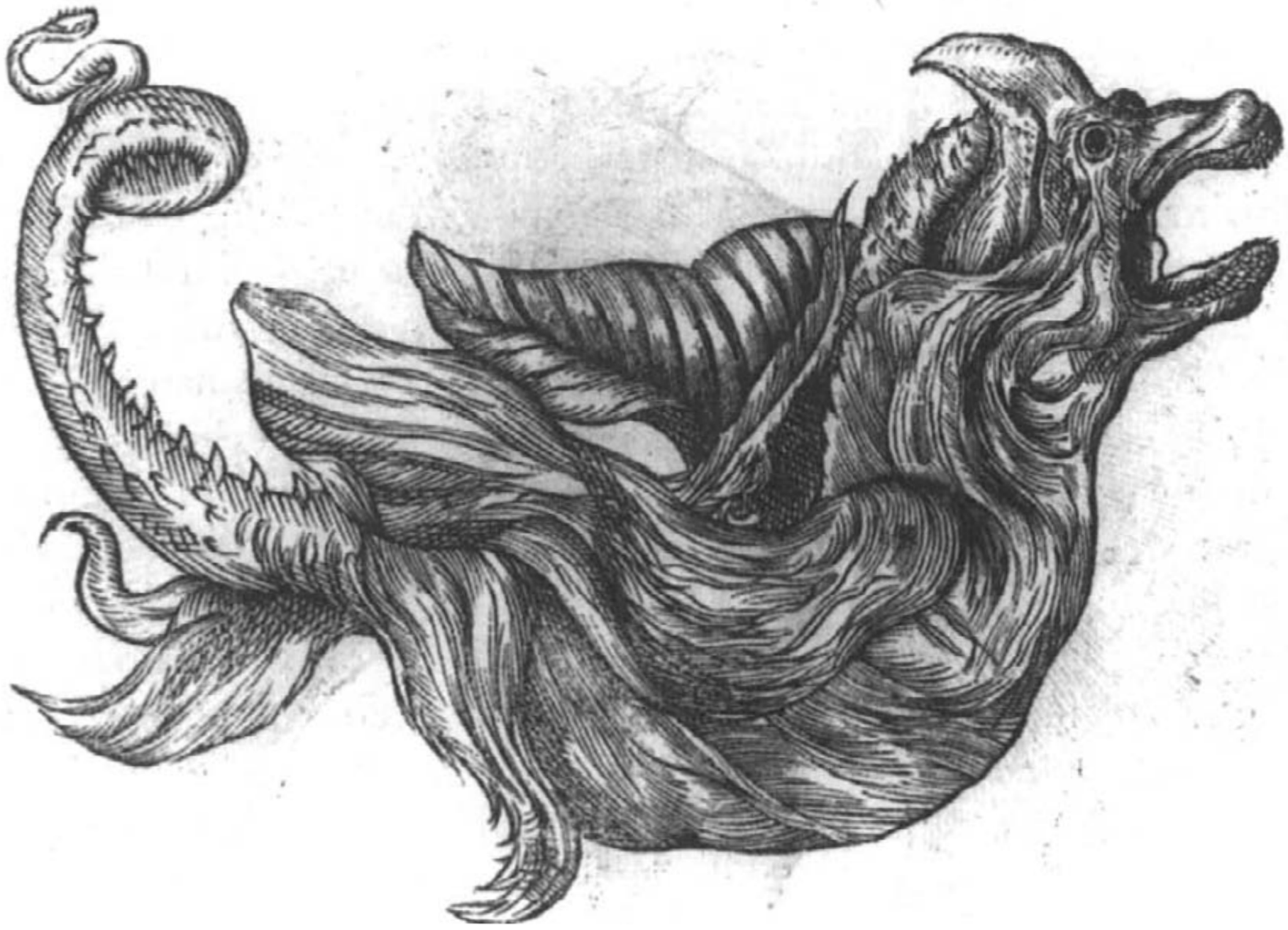

Figure 12.4 The "dragon formed a ray" in Ulisse Aldrovandi's museum in Bologna. Source: Ulisse Aldrovandi, *De piscibus* (Bologna, 1613). Courtesy of Department of Special Collections, Stanford University Libraries.

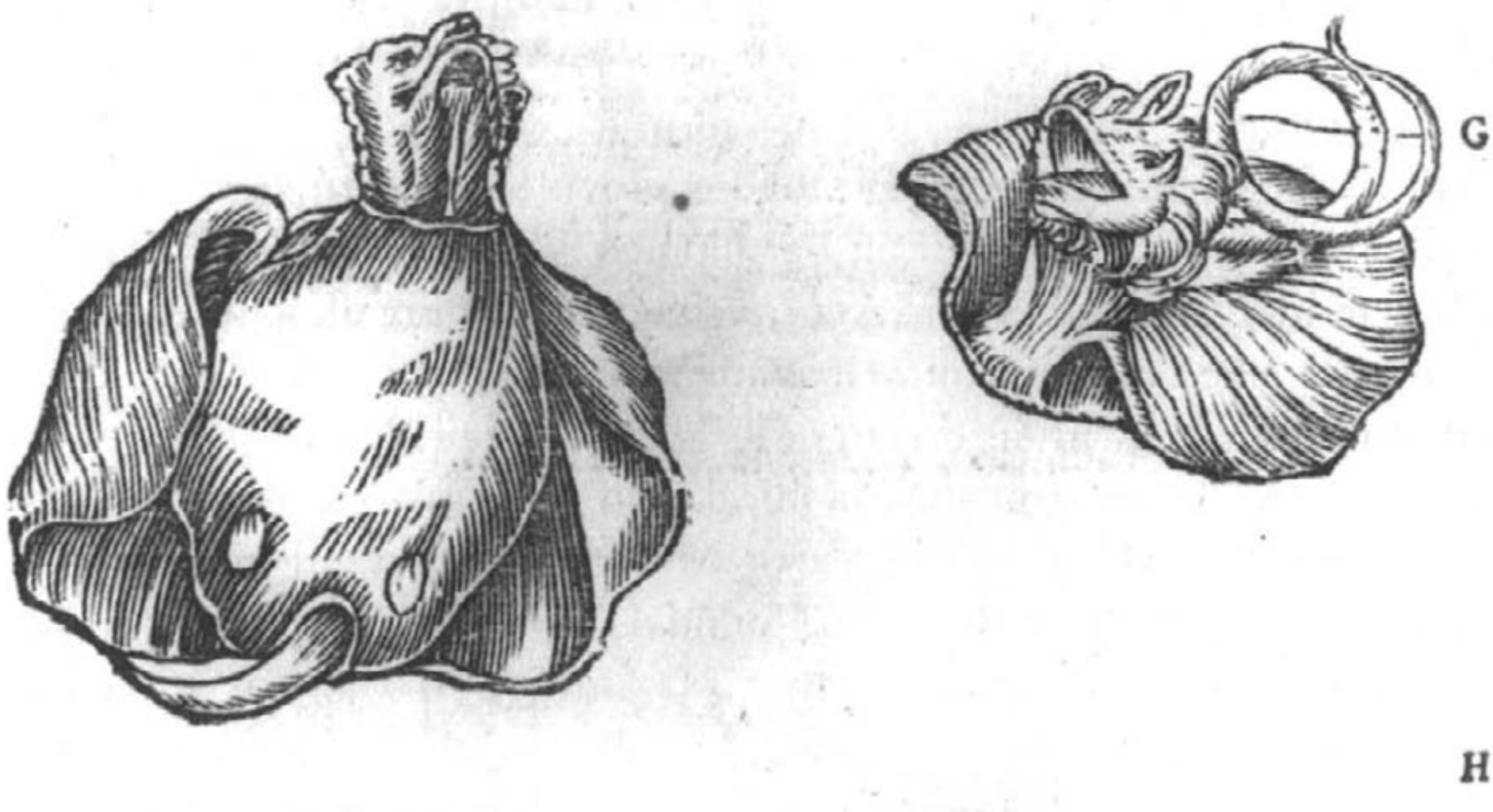

Figure 12.5 Aldrovandi's basilisk. Source: Ulisse Aldrovandi, *Serpentum et draconum historiae libro duo*, ed. Bartolomeo Ambrosini (Bologna, 1640). Courtesy of Department of Special Collections, Stanford University Libraries.

Andrea Mattioli. In the expansion of his 1544 commentary on Dioscorides's *De materia medica*, the leading handbook on medicinal simples since antiquity, Mattioli added a section on poisons. The final chapter of his popular commentary was devoted to the basilisk. "The variety of stories makes me easily believe that one can't determine anything about this animal," wrote Mattioli, "or know what its true history might be among all the stories told."[49] Nonetheless he proposed a few logical questions about the idea of the basilisk that reflected the growing numbers of specimens in cabinets of curiosities. How could something so dangerous that it could kill men instantly be so easily captured? If it were so small, how could men, observing it from a safe distance, see enough of its features to report on details such as the three points on the crested head, or the crown that it was often thought to wear? The basilisk, after all, had no Hercules to slay it like the hydra, nor a tale equivalent to the decapitation of the deadly Medusa. Only divine providence, or human delight in the endless invention of nature, could bring it into the museum.

The longevity of the basilisk, well beyond the period in which there was any doubt about its authenticity, suggests the importance of understanding the relations between science and art in the early modern period. Certainly the decision to make basilisks a prominent part of the iconography of natural history was a contributing factor. Each image created a prototype of an object that could be made by looking at its engraving, and remade by copying these images into new natural histories. Aldrovandi's fake dragons enjoyed a wide circulation in the seventeenth century. They reappeared in later editions of Aldrovandi's posthumous natural history and eventually found their way into Joannes Jonstonius's *Natural History of Serpents* (1657). In this work, Jonstonius brought together all of Aldrovandi's images to demonstrate the art of inventing nature (fig. 12.6). When it came to the basilisk, Jonstonius offered no lengthy discussion of its physical form, customs, and mythology, as earlier naturalists had done. He simply noted: "They are formed from a ray, just as one can see from this image. Preserved in the Bologna Museum."[50]

By 1622, connoisseurs of basilisks could enjoy a competing image of this dragon by turning to page 90 in the new and improved catalog of Calzolari's museum written by Benedetto Ceruti and Andrea Chiocco, two Veronese physicians in contact with the apothecary's grandson (fig. 12.7). There was a splendid portrayal of all the unique features of the basilisk, with a level of detail that no previous image had captured: the diadem decorating its crested forehead, the scales covering its wings and tail, the strange fins on which it balanced, and, most importantly, the act of flight. The engraver had succeeded in bringing the basilisk to life. Lest there be any confusion, Ceruti warned his readers: "You should know, lest any lies are discovered in our nomenclature, that this is neither a basilisk nor a dragon, but a fish from the

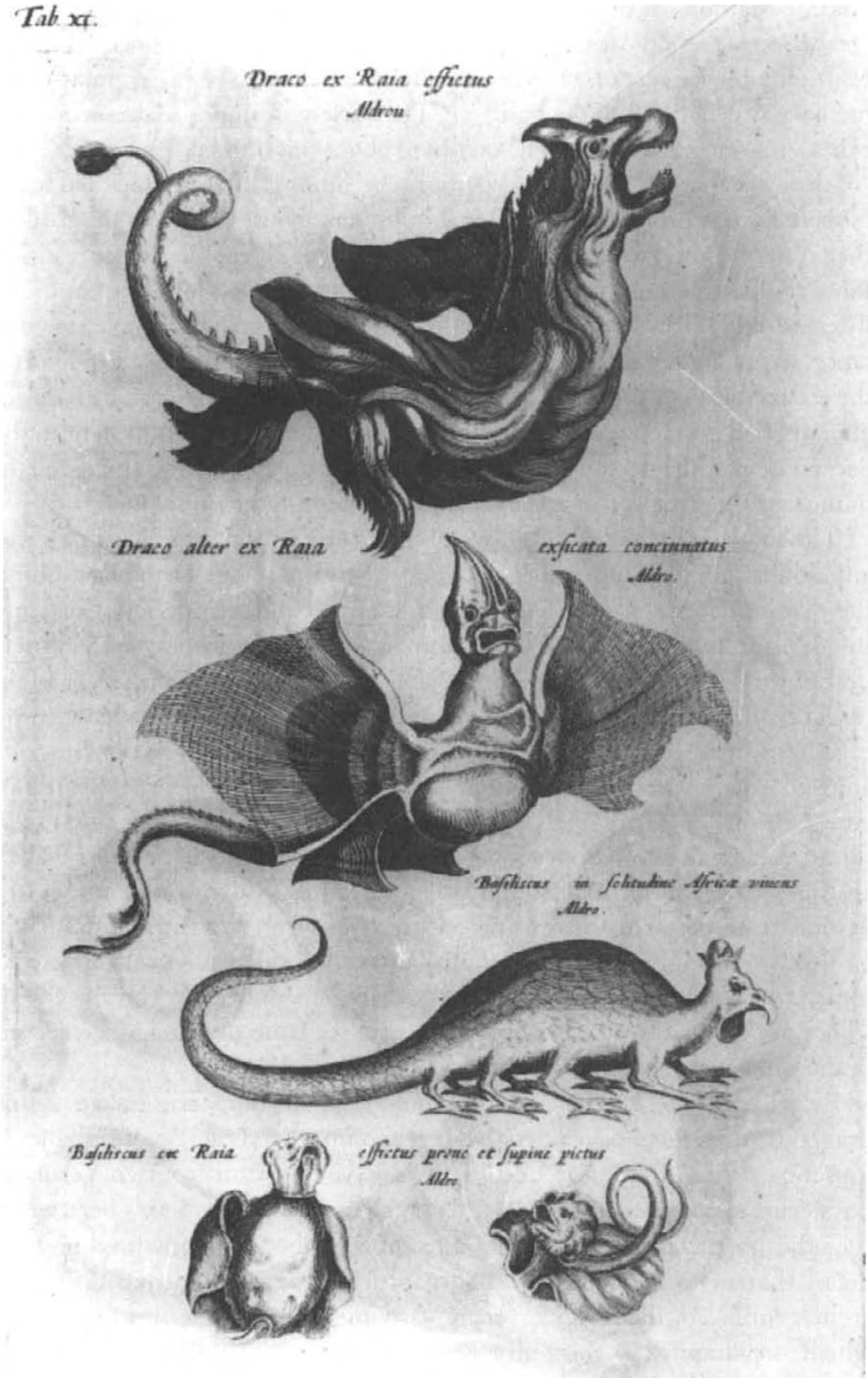

Figure 12.6 Joannes Jonstonius' reproduction of Aldrovandi's invented dragons. Joannes Jonstonius, *Historia naturalis de serpentibus libri II* (Amsterdam, 1657). Courtesy of the Biblioteca Nazionale Centrale, Florence.

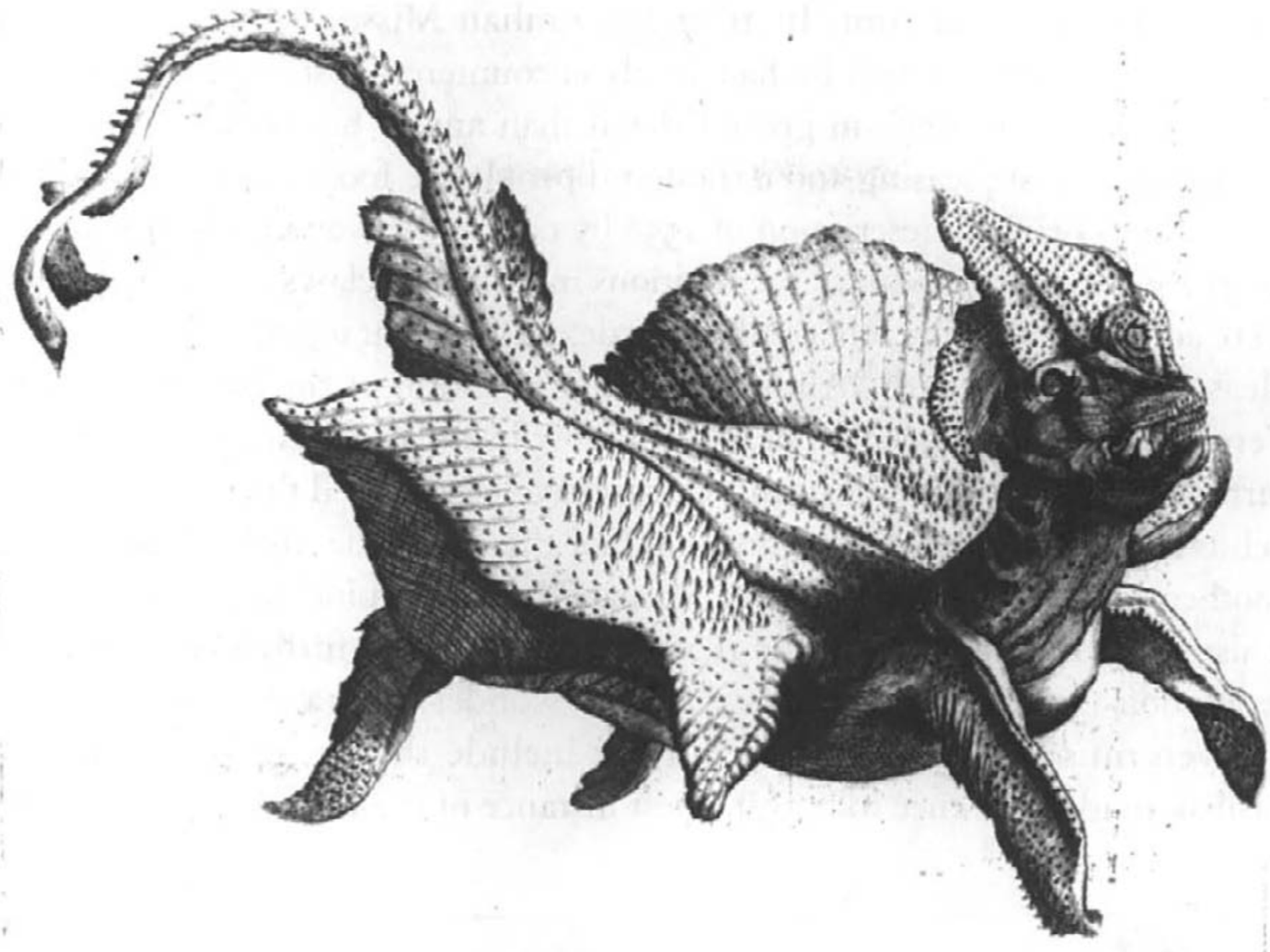

Figure 12.7 Calzolari's basilisk in Verona. Source: Benedetto Ceruti and Andrea Chiocco, *Musaeum Franc[isci] Calceolarii Iun[ioris] Veronensis* (Verona, 1622). Courtesy of the Biblioteca Nazionale Centrale, Florence.

sea — an ill-shaped ray of course worked into this shape by the hand of an artisan." He invited his readers to admire how Calzolari's monster, "exhibited for viewing," imitated the shape of the basilisk.[51]

Calzolari's engraved basilisk quickly supplanted Aldrovandi's illustrations as the canonical depiction of an object that *did* exist, even if the animal did not. When Lodovico Moscardo published two catalogs of his own collection in 1656 and 1672, he reproduced Calzolari's image. Of course in Moscardo's case it is not unlikely that he had Calzolari's actual basilisk, since both collectors came from the same city. It was in regard to this particular basilisk that he offered the opinion that it "had been shaped in this way by swindlers and charlatans from Dalmatia, and shown by them in public stands to the people as a true basilisk."[52] The image, in other words, now fully demonstrated the art of invention and the collector's role as a critical consumer in the marketplace of marvels.

The power of Calzolari's image and its circulation in various catalogues throughout the seventeenth-century attracted visitors to Moscardo's museum who wanted to inspect the art of the basilisk. Catalogs gave objects a double life; visitors experienced them both in word and image, before see-

ing them in the museum. In 1687 Maximilian Misson stood in front of Moscardo's basilisk, which he had surely encountered first in print, and discussed how it was made in greater detail than any of his predecessors: "the invention is most pleasing and a thousand people are fooled by it." He added to Gessner's original description of 1558 by noting the way in which a darted tongue was neatly fitted into the fictitious mouth, and claws and enamel eyes were added "with some other little parts dexterously put together." With great pleasure, he concluded, "And voilà! The invention of the basilisk."[53] The Verona basilisk did not disappear from view in the next century, but gained further currency as naturalists more aggressively cultivated their reputation as debunkers of ancient superstitions. When the catalogue of the Nuremberg apothecary Basil Besler and his son Michael Rupert's cabinet appeared in 1716, it also contained an image of the 1622 Calzolari basilisk, further cementing its reputation as the measure of this particular wonder (fig. 12.8).

Even museum catalogs that did not include the image of Calzolari's basilisk made reference to it as the best instance of the engraver's art captur-

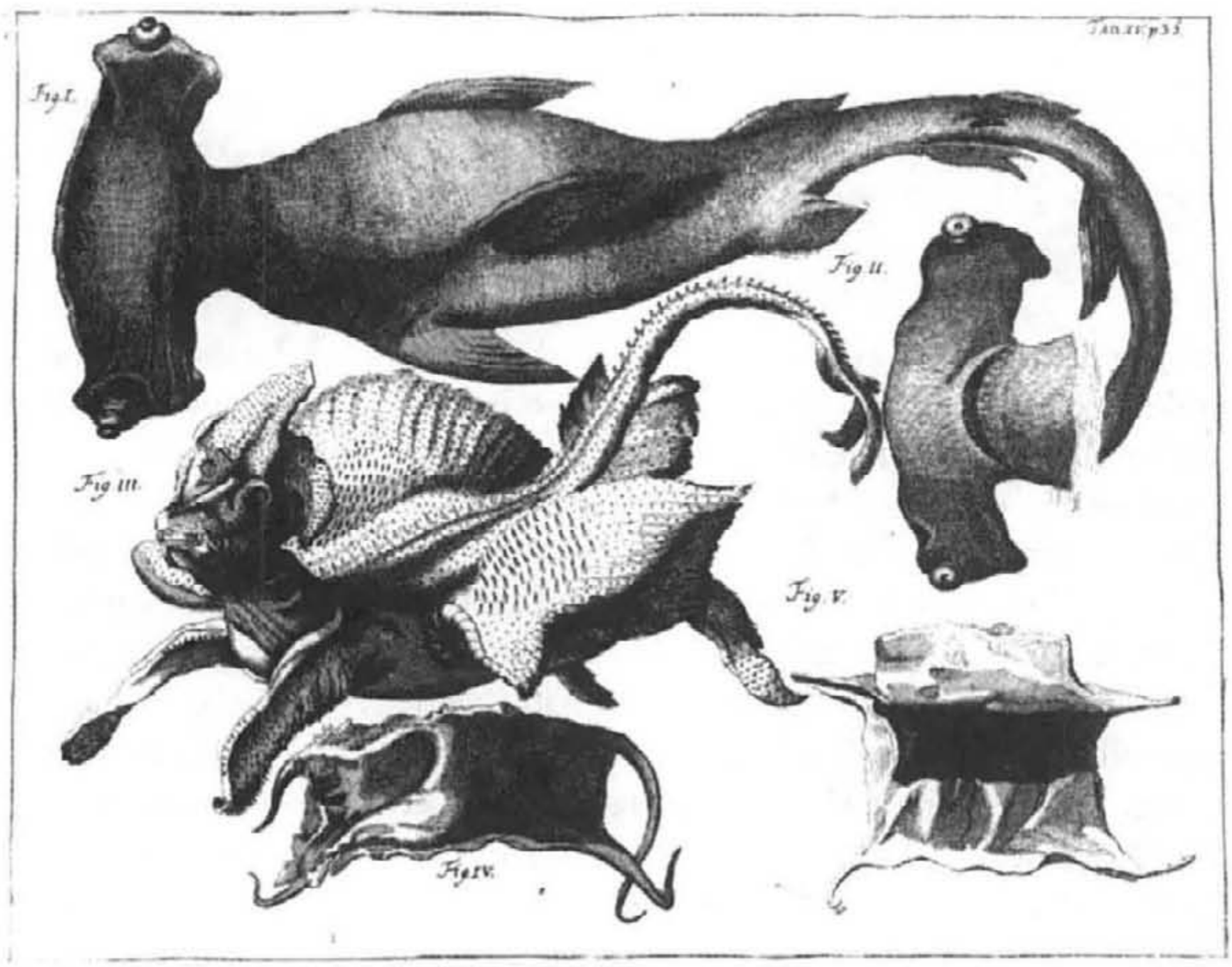

Figure 12.8 Basil and Michael Rupert Besler's basilisk, with a demonstration of how it was made from a ray. Source: *Rariorum Musei Besleriani quae olim Basilius et Michael Rupert Besler collegerunt, aeneisque tabulis ads vivum incisa evvulgarunt: nunc commentariolo illustrata a Johanne Henrico Lochnero* (Nuremberg, 1716). Courtesy of the Biblioteca Nazionale Centrale, Florence.

ing the fabrication of nature. The papal physician Johan Faber, for instance, referred to the "most beautifully engraved figures" of the basilisk in flight in the Ceruti and Chiocco catalog to highlight the unusual appearance of a dragon's skeleton he included in his edition of the Spanish royal physician Francisco Hernández's famous *Treasure of Medical Things of New Spain* (1649) (fig 12.9).[54] Cardinal Francesco Barberini's dragon had been carefully inspected by Faber, who pronounced it authentic in every respect. One way to demonstrate its authenticity was to depict it in a manner different from the Calzolari basilisk because it had become the canonical image of the invention of nature.

There were many technical reasons to admire the Calzolari image. In comments such as Faber's we get a glimpse of the naturalist as a savvy consumer of the art of printing as a technique for reproducing nature. By the time Lorenzo Legati composed the 1677 catalog of Marchese Ferdinando Cospi's museum in Bologna, he was no longer satisfied with Aldrovandi's depictions of the basilisk. While referring his readers to the images of 1640—which were actually woodcuts done at the end of the sixteenth century—he told them that the image of the Calzolari basilisk more closely approximated the object he was trying to describe. "Other than being most finely engraved

Figure 12.9 Cardinal Francesco Barberini's dragon in Rome, as described by papal physician Johan Faber. Source: Francisco Hernández, *Rerum medicarum novae hispaniae thesaurus seu plantarum animalium mineralium Mexicanorum Historia ex Francisci Hernandez*, ed. Johan Faber (Rome, 1649). Courtesy of Bancroft Library, University of California, Berkeley.

in copper, it also articulates the spines and roughness of the tail that one doesn't observe in the first figures."[55] Legati did not follow Moscardo's example of including the image, on the presumption that readers of his catalog would simply turn to a copy of the 1622 catalog to confirm his opinion. In a much more decisive way, Legati reminded his audience that depicting a dubious nature was a special kind of art.

Only one seventeenth-century scholar took the image that Faber created in the 1640s to be a better likeness of a dragon. Both the image and description of Faber's dragon appeared prominently in the German Jesuit Athanasius Kircher's *Subterranean World* (1664).[56] But this was hardly surprising since Kircher was in the midst of dissecting a dragon's head with the Barberini librarian Hieronymus Lancia after a flying dragon made its appearance in Rome in 1660. Kircher was perhaps the last naturalist to believe passionately in the reality of any papal dragon he saw, even though he knew well the stories of basilisks invented from rays. His successor as curator of the Roman College museum, the Jesuit naturalist Filippo Bonanni, tactfully chose not to discuss the Barberini dragons, confining his comments instead to a splendid example of a dried ray "sold by some as a basilisk." It was surely one of the two rays "formed by art" that Giorgio de Sepi described in the 1678 catalog of Kircher's collection.[57] By the end of the seventeenth century, the vast majority of naturalists agreed with Ceruti that hydras, basilisks, and dragons existed only to the extent to which artisans and engravers could bring them to life.

MONSTROUS CODA: THE LAST HYDRA FOR SALE

No account of the early modern invention of nature, however, ends without the moral that belief is more powerful than any number of criticisms that might demolish it. The last hydra to preoccupy the community of naturalists belonged to two merchants in Hamburg. In the city of Amsterdam, the apothecary Albert Seba routinely enjoyed the company of visitors to his famous cabinet of curiosities. Around 1720, he began to hear tales of the hydra of Hamburg (fig. 12.10). At first, he dismissed it as a mere fable. A year later, a minister told him the same story and brought him an image of the hydra. But what finally convinced Seba that he needed to know more about the hydra was its price. "When I heard that it was for sale for 10,000 florins, a detail he confirmed, the immensity of the sum reawakened my desire to have a faithful copy of it." Seba's response to the hydra was not all that different than his contemporary Antonio Vallisnieri's reaction to the basilisk. Vallisnieri, one of the famed professors of natural history who practiced the kind of critical, microscopic natural history that his mentor Mar-

Figure 12.10 The hydra of Hamburg, engraved for Albert Seba. Source: Albert Seba, *Locupletissimi rerum naturalium thesauri accurata descriptio, et iconibus artificiosissimis expressio, per universam physices historiam* (Amsterdam, 1734), vol. 1, table CII. Courtesy of Bancroft Library, University of California, Berkeley.

cello Malpighi pioneered, kept a basilisk in his collection in Padua in the early eighteenth century because he could not believe the "high price" that an "Armenian trickster" had gotten for it.[58]

Commerce indeed was the final wonder of the art of inventing nature. Both truth and falsehood had their price. Seba immediately wrote to a fellow apothecary in Hamburg, asking his opinion of the hydra. "He assured me that it was in no way a work of art, but truly one of nature."[59] The apothecary Natorp provided the "faithful copy" that Seba requested for him to see what kind of hydra it was. Seba subsequently circulated it widely among connoisseurs of curiosities by making it the most dramatic illustration in the 1734 catalog of his Amsterdam collection, even though he had no direct claim on the hydra. Shortly thereafter, young Linnaeus would declare that it was probably the fabrication of monks—not unlike the "basilisk's tongue in two pieces" and the "two basilisk skeletons in pieces" that the abbot Matteo Priuli kept in his collection in Padua at the end of the seven-

teenth century. Debunking the hydra became part of Linnaeus's mythology as a modern naturalist.[60] Yet what we miss in such an account is Linnaeus's admiration for the hydra of Hamburg—a response to the fabrication of nature that he shared with Seba and all the naturalists who preceded them. The price on the hydra may have declined precipitously thereafter, but it was still a work of art.[61]

Notes

1. See especially Lorraine Daston and Katharine Park, *Wonders and the Order of Nature 1150–1750* (New York: Zone Books, 1998); and Jean Céard, *La nature et les prodiges. L'insolite au siezième siècle* (Geneva: Droz, 1977); Ottavia Niccoli, *Prophecy and People in Renaissance Italy*, trans. Lydia G. Cochrane (Princeton, N.J.: Princeton University Press, 1990); and William Burns, *An Age of Wonders: Prodigies, Providence, and Politics in England, 1658–1727* (Manchester: Manchester University Press, 2001).

2. Nicolò Serpetro, *Il mercato delle maraviglie della natura overo storia naturale* (Venice, 1653), n. p., "Introdutione per chi legge."

3. Tommaso Garzoni, *Piazza universale di tutte le professioni del mondo*, ed. Paolo Cherchi (Turin: Einaudi, 1996).

4. See Anne Goldgar's essay in this volume.

5. John Evelyn, *The Diary of John Evelyn*, ed. William Bray (London: Bickers and Son, 1906), Vol. 1, 51 (Paris, 3 February 1644).

6. The role of gifts in early modern natural history is discussed in Paula Findlen, "The Economy of Scientific Exchange in Early Modern Italy," in *Patronage and Institutions: Science, Technology and Medicine at the European Courts, 1500–1750* (Woodbridge, U.K.: Boydell & Brewer, 1991), 5–24; Giuseppe Olmi, "'Molti amici in varii luoghi': Studio della natura e rapporti epistolari nel secolo XVI," *Nuncius* 6 (1991): 3–31; and Brian Ogilvie, *Observation and Experience in Early Modern Natural History* (Ph.D. diss., University of Chicago, 1997), esp. 8, 129–130, 241–242.

7. Hans-Olof Boström, "Philipp Hainhofer and Gustavus Adolphus's *Kunstschrank*," in *Origins of Museums: Cabinets of Curiosities in Early Modern Europe*, ed. Oliver Impey and Arthur MacGregor (Oxford: Clarendon Press, 1983), 91. For further discussion of this approach to a cabinet of curiosities, see Pamela H. Smith, *The Business of Alchemy: Science and Culture in the Holy Roman Empire* (Princeton, N.J.: Princeton University Press, 1994).

8. See Mark Meadow's and Harold Cook's essays in this volume for more on Hans Jacob Fugger and Jan Swammerdam.

9. John Ray, *Observations Topographical, Moral, & Physiological; Made in a Journey Through part of the Low-Countries, Germany, Italy, and France* (London, 1673), 237; and Philip Skippon, *An Account of a Journey Made Thro' Part of the Low-Countries, Germany, Italy, and France*, in *A Collection of Voyages and Travels*, eds. A. and S. Churchill (London, 1752), Vol. 6, 565.

10. Many of the essays in *Cultures of Natural History*, ed. Nick Jardine, James Secord, and Emma Spary (Cambridge: Cambridge University Press, 1995), touch upon this theme.

11. The commercial aspect of Columbus's interest in nature should be considered alongside those elements described in Mary Campbell, *The Witness and the Other World: Exotic European Travel Writing 400–1600* (Ithaca, N.Y.: Cornell University Press, 1988); and Stephen Greenblatt, *Marvelous Possessions: The Wonder of the New World* (Chicago: University of Chicago Press, 1991).

12. Theriac was an ancient medicine, described in great detail by Galen and composed of numerous ingredients that allegedly cured all manner of poisons. It was increasingly taken as a preventive medicine in an era of frequent plague epidemics. See Findlen, *Possessing Nature: Museums, Collecting, and Scientific Culture in Early Modern Italy* (Berkeley: University of California Press, 1994), ch. 5.

13. Patrick Geary, *Furta Sacra: Thefts of Relics in the Central Middle Ages* (Princeton, N.J.: Princeton University Press, 1978), indicates the extent of the passion for relics whose value escalated to such a degree that people stole as well as bought them.

14. Daston and Park, *Wonders*, 69, 74.

15. This marvelous passage is discussed in Ogilvie, *Observation*, 241.

16. Biblioteca Universitaria, Bologna (hereafter BUB), *Aldrovandi*, ms. 136, Vol. 9, c.5v (Castelletti to Aldrovandi, Genova, 22 February 1579).

17. See, for example, Ulisse Aldrovandi, *De piscibus libri V* (Bologna, 1613), 401. "De centrine" describes fish he acquired from Castelletti, who called them "verae ac genuinae."

18. BUB, *Aldrovandi*, ms. 136, Vol. 9, c.129r (Castelletti to Aldrovandi, n.d.)

19. Archivio di Stato, Pisa, *Università*, 530, c.2r (*Spese occorse nel viaggio fatto da un semplicista per ritrovare piante e minerali*); 518 (16 April 1604). This material is also discussed in Lucia Tongiorgi Tomasi, "Arte e natura nel Giardino dei Semplici: dalle origini alla fine dell'età medicea," in *Giardino dei Semplici: l'Orto botanico di Pisa dal XVI al XX secolo* ed. Fabio Garbari, Lucia Tongiorgi Tomasi, and Alessandro Tosi (Ospedaletto: Pacini, 1991) 162.

20. Ambroise Paré, *On Monsters and Marvels*, trans. Janis L. Pallister (Chicago: University of Chicago Press, 1980), 128.

21. BUB, *Aldrovandi*, ms. 38, Vol. 4, f.46 (Antonio Anguissola, Piacenza, 12 April 1568). The Italian original literally describes Master Leone as someone who "monta in bancho spesso"—the origins of the word "mountebank."

22. The fascinating story of Leone Tartaglini has been reconstructed in Achille Forti, "Del drago che si trovava nella Raccolta Moscardo e di un probabile artefice di tali mistificazioni: Leone Tartaglini da Foiano," *Madonna Verona* 8 (1914): 26–51; and idem, "Il Basilisco esisente al Museo Civico di Storia Naturale a Venezia e gli affini simulacri finora conosciuti. Contributo alla storia della ciarlataneria," *Atti del Reale Istituto Veneto di scienze, lettere ed arti* 87, part 2 (1928–29): 225–238.

23. Skippon, *Account of a Journey*, 517. Compare with Ray, *Observations*.

24. Lodovico Moscardo, *Note overo memorie del Museo del Conte Lodovico Moscardo nobile veronese* (Verona, 1672), 235. Moscardo called them "ciurmatori, ò Zaratani." Achille Forti makes the interesting suggestion that the spelling of the last word indicated a kind of charlatan who came from Dalmatia into northern Italy so I have indicated this possibility in the translation. Forti, "Del drago," 30.

25. Conrad Gessner, *Historia animalium* (Tiguri, 1558), 4, 945.

26. Mario Cermenati, "Francesco Calzolari e le sue lettere all'Aldrovandi," *Annali di botanica* 7 (1908): 48 (Verona, 16 December 1571).

27. Ray, *Observations*, 27, 219.

28. BUB, *Aldrovandi*, ms. 136, Vol. 5, f. 179r. This episode is also discussed in Conor Fahy, *Printing a Book at Verona in 1622: The Account Book of Francesco Calzolari Junior* (Paris: Fondation Custodia, 1993), 20.

29. For more on this subject, see Pamela Smith's forthcoming book on artisans and science in early modern Europe.

30. Girolamo Cardano, *De rerum varietate*, in *Opera Omnia* (Leiden, 1663), Vol. 3, 342. Also discussed in Daston and Park, *Wonders*, 167.

31. Leonardo da Vinci, *The Notebooks of Leonardo da Vinci*, ed. Irma A. Richter (Oxford: Oxford University Press, 1952), 167. The original is in ms. A, f. 20r.

32. Colin Eisler, *Dürer's Animals* (Washington, D. C.: Smithsonian Institution Press, 1991), 311–312.

33. This formulation is found in Daston and Park, *Wonders*, 74, in their discussion of the medieval treasury. Since the treasury was the original location of many hydras and basilisks, it seems all the more fitting.

34. Conrad Gessner, *Nomenclator aquatilium animantium. Icones animalium* (Tiguri, 1560), 362–363. Compare with Conrad Lycosthenes, *Prodigorum ac ostentorum chronicon* (Basel, 1657 ed.), 538–539. For further discussion of the religious significance of the hydra, see *Mythical Beasts*, ed. John Cherry, (London: British Museum Press, 1995), 20, 35–36.

35. BUB, *Aldrovandi*, ms. 21, Vol. 4, c. 89v.

36. Ulisse Aldrovandi, *Serpentum et draconum historiae libro duo*, ed. Bartolomeo Ambrosini (Bologna, 1640), 387. See the second hydra, which is evidently the hydra of Ferrara: "Hydra septiceps Equitis de Corneto affectatoris olim Sereniss. Ducis Ferrariae."

37. Edward Topsell, *Historie of Four-Footed Beastes* (London, 1607), 202.

38. Skippon, *Account of a Journey*, 565. "Zennon" is probably Giacomo Zanoni, a well-known Bolognese apothecary whom many collectors visited in the mid-seventeenth century. See also John Evelyn's account of a fifteen-headed hydra in the Villa Ludovisi in Rome that he saw in 1645; (*The Diary of John Evelyn*, ed. E. S. de Beer [Oxford: Clarendon Press, 1996, 1951], Vol. 2, 391).

39. Pierre Belon, *L'histoire naturelle des estranges poissons* (Paris, 1551),18r. For a general discussion of fake animals, see E. W. Gudger, "Jenny Hanivers, Dragons and Basilisks in the Old Natural History Books and in Modern Times," *Scientific Monthly* 38 (June 1934): 511–523; Richard Carrington, *Mermaids and Mastodons: A Book of Natural and Unnatural History* (New York: Rinehart & Company, 1957); and Peter Dance, *Animal Fakes and Frauds* (Berkshire, UK: Sampson Low, 1976).

40. Gessner, *Historia animalium*, 945. Compare with Maximilian Misson, *Nouveau voyage d'Italie,* 5th ed. (La Haye, 1731), Vol. 1: 161–162.

41. See Daston and Park, *Wonders*; and Niccoli, *Prophecy*.

42. Carrington, *Mermaids and Mastodons*, 69–70. I have modified Carrington's translation of the passage in order to conform with other translations of "raia" as "ray."

43. Paré, *On Monsters and Marvels*, 109.

44. Cardano, *De rerum varietate*, 343.

45. Eisler, *Dürer's Animals*, 265, 321. An excellent example of a carved dragon can be found in the Museo degli Argenti in Florence, part of the Medicis' famous collection of worked objects.

46. Aldrovandi, *De piscibus*, 437, 443–444. I have wondered if the sea-eagle might not be Castelletti's bulging-eyed fish? The most detailed discussion of the sources of Aldrovandi's imagery can be found in Erminio Caprotti, *Mostri, draghi e serpenti nelle silografie dell'opera di Ulisse Aldrovandi e dei suoi contemporanei* (Milan: Gabriele Mazzotta, 1980).

47. For a classic description of the basilisk, see Lycosthenes, *Prodigorum*, 22; also Jacques Grevin, *De venenis libri duo* (Antwerp, 1571), ch. 18.

48. Aldrovandi, *Serpentum*, 364.

49. Pier Andrea Mattioli, *De i discorsi di M. Pietro Andrea Matthioli . . . Nelli sei libri di Pedacio Dioscoride Anazarbeo* (Venice, 1585 ed.), 1526–1527.

50. Joannes Jonstonius, *Historia naturalis de serpentibus libri II* (Amsterdam, 1657), 34.

51. Benedetto Ceruti and Andrea Chiocco, *Musaeum Franc[isci] Calceolarii Iun[ioris] Veronensis* (Verona, 1622), 90–91.

52. Moscardo, *Note*, 235.

53. Misson, *Nouveau voyage*, Vol. 1, 161.

54. Francisco Hernández, *Rerum medicarum novae hispaniae thesaurus seu plantarum animalium mineralium Mexicanorum Historia ex Francisci Hernandez*, ed. Johan Faber (Rome,

1649), 818. This text is discussed in greater detail in Silvia de Renzi, "Herodotus and the Microscope: Investigating Dragons in Seventeenth-Century Rome" (unpublished paper). I thank Dr. de Renzi for providing me with a copy.

55. Lorenzo Legati, *Museo Cospiano* (Bologna, 1677), 81.

56. Athanasius Kircher, *Mundus subterraneus* (Amsterdam, 1678), 103–108.

57. Filippo Bonanni, *Musaeum Kircherianum* (Rome, 1709), 270; Giorgio de Sepi, *Romani Collegii Societatis Jesu Musaeum Celeberrimum* (Amsterdam, 1678), 27. He concluded: "They are deformed rays and putative basilisks and, in the author's opinion, made by art and not by nature." There is no doubt that this opinion was also Kircher's, suggesting that he shared Aldrovandi's view of the distinctions between true dragons and false basilisks.

58. Antonio Vallisnieri, *Opere fisico-mediche* (Venice, 1733), Vol. 3, 370. Vallisnieri"s biographer C. Lodoli also discussed how he showed the basilisk to "reveal the monstrous deceptions perpetrated in other museums where much was made of miraculous works of nature such as basilisks, fabulous hydras, petrified bread and fungi and other similar nonsense." Ibid., Vol. 1, LVI. This latter passage is discussed in Krzysztof Pomian, *Collectors and Curiosities: Paris and Venice, 1500–1800*, trans. Elizabeth Wiles-Portier (London: Polity, 1990), 104.

59. Albert Seba, *Locupletissimi rerum naturalium thesauri accurata descriptio, et iconibus artificiosissimis expressio, per universam physices historiam* (Amsterdam, 1734), Vol. 1, table 102, 159.

60. Pomian, *Collectors*, 103. On the hydra of Hamburg, see Colin Clair, *Unnatural History: An Illustrated Bestiary* (London: Aberlard-Schuman, 1967), 211–212, 235; and Dance, *Animal Fakes*, 33–36. For an excellent introduction to Linnaeus, see Lisbet Koerner, *Linnaeus: Nature and Nation* (Cambridge, Mass.: Harvard University Press, 1999).

61. Samuel Butler's *Hudibras* recounts a less well-known story—a send-up of the whole cult of fictitious nature—about a dead rat that James Bobart found in the Oxford physick garden in the late seventeenth century and turned into a dragon to see who would believe him. Yet after he revealed the joke, the dragon remained in the cabinet of curiosities associated with the Oxford anatomy theater, "looked upon as a masterpiece of art." In Dance, *Animal Fakes*, 59.

Nature as Art

The Case of the Tulip

ANNE GOLDGAR

"When Homer sang in ancient times at Corinth, no one listened to his verses. In our own era in Paris, Poussin earned too little to live." These lines bewailing philistinism, published by Nicolas de Valnay in 1669, were written, rather surprisingly, in defense of the tulip. Valnay, contrôleur of Louis XIV's household and a member of a loose group of *curieux* devoted to flowers, expressed surprise at the preference some felt for other curiosities, such as paintings, medals, or porcelains. Look at such things as long as you like, he wrote, but you will always be looking at the same thing. Not so with the wonderful annual variety of flowers, of which the tulip was the queen. The beauties of painting, moreover, are all in design, execution, and color; but "I challenge the entire Académie de Peinture to imagine flowers better than natural ones, to execute them in complete perfection, or ever to approach the colors of Flowers." If you own a painting, you will always have only one, but bulbs have the advantage of multiplying themselves. The consequence of this (although Valnay did not put it this way) is social: you can give a rare flower to a friend and yet still keep the same thing, not a copy, for yourself. These arguments against painting, Valnay said, could also be made against medals, porcelains, and other fashionable rarities: "when reason is combined with taste, beautiful flowers will hold the first rank among the pleasures of sight."[1]

Valnay's view that the times were too "blind and insipid" for flowers like tulips—that they suffered from the poor taste of the public, as painting and poetry had also sometimes suffered—is something of an exaggeration.[2] Although the tulip would not find again such passionate advocacy as it did in the period leading up to the tulipmania of 1634–37, it enjoyed a healthy popularity, particularly among a circle of professional men, merchants, and gentry, both in France and in equivalent social groups in other European

countries such as the Netherlands, England, Italy, and the German states. But what is interesting in Valnay is not chiefly the strength of his views, views expressed by other enthusiasts over the years, such as Crispijn van de Passe in the Netherlands, Jean Franeau in Flanders, Sir Thomas Hanmer in England, or the Sieur de La Chesnée Monstereul in France. The interest lies rather in Valnay's treatment of tulips as works of art. This essay will explore the complex of ideas and attitudes that allowed such a comparison, and, further, the social consequences that sprang from making it.

Grappling with the relationship between art and nature was hardly new in the seventeenth century. As Lorraine Daston and Katharine Park have delineated in a richly suggestive chapter of their *Wonders and the Order of Nature*, the opposition between the forces of nature and art was an ancient paradigm, still crucial in the seventeenth century even as natural philosophy began first to break it down and then to change its terms.[3] From the days of Zeuxis and Parrhasius, artists have made a strong case for the superiority of their craft to the creative powers of nature.[4] With the strengthening view in the Renaissance that the artist's *ingegno* was akin to that of the creating God, the view of art as surpassing nature became ever more influential.[5] Early modern comments about floral still life make this clear. Painters of flowers were considered to improve on nature if they were talented at depicting texture, and, as Paul Taylor has pointed out, the desire to idealize the flowers in paint and thus perfect imperfect nature was a powerful impulse for artists.[6] Thus the triumphs of Zeuxian grapes were brought up to date with verses praising Daniel Seghers' painted roses. According to Huygens in 1645, "Nature as judge, conceded defeat in the contest:/The painted flower rendered the real one a shadow."[7]

But art had not quite won this battle with nature, and Seghers could prove just as potent an argument for the other side. Proponents of the glories of flowers, for example, also cited Seghers, but now to stress his supposed inability to do justice to them in paint. Flower breeders John Rea and his son-in-law Samuel Gilbert favored real tulips over their portrayal by "Pater Zegers, a Jesuite in *Antwerp*, famous for painting flowers," Rea commenting of a tulip called the Agate Hanmer, "Her Native Beauties shaming Art, / Once did that famous Jesuite try / To copy out her Majesty; But falling short of his desire, / He left his Pencil to admire."[8] Despite artists' tradition of challenging God and nature with their *ingegno*, in the seventeenth century some voices, including, naturally enough, those of various botanists and gardeners, continued to maintain that art could do nothing to imitate the beauties and wonders of some natural objects.

The traditional division represented here, seen in the usual classification of collections into *naturalia* and *artificialia*, was precisely one that the later sixteenth and seventeenth centuries delighted in undermining.[9] There was a

pleasure in blurring the boundaries between art and nature, to be seen in artificial objects resembling natural ones, such as Palissy's ceramics or the mechanical rainbows and songbirds to be found in the Villa Aldobrandini at Frascati.[10] More important for our purposes are the many natural objects in collections turned half into *artificialia* by gilding, etching, carving, or artistic arrangement. Coconuts, ostrich eggs, or rhinoceros horns transformed into reliquaries; nautilus shells etched and gilded into luxurious beakers; reindeer antlers fashioned into candelabra: all testified to the desire of artists and collectors to intertwine nature with art.[11]

A coconut carved with a biblical scene or a nautilus cup engraved with the image of other shells and sea creatures not only illuminates the status of objects that are half art and half nature. Such objects also demonstrate to us a desire for art to conquer nature. A nautilus shell itself was sometimes not enough; the hand of man had to alter it and beautify it as well. These attitudes have been elaborated in recent work on the *Kunstkammer* and its objects. What has not so far been examined by scholars, however, is a further step along this path. Man could impress himself upon natural objects by gilding, etching, and engraving; but there were also objects that, although remaining entirely natural, yet were evisaged as art. The tulip is one such object, fascinating and enigmatic precisely because of this special mixture of art and nature. What, then, did it mean for Valnay to place it in the same category as a painting or a piece of porcelain?

Even in 1669, when Valnay was writing, tulips remained exotic items. They had arrived in Europe in the mid-sixteenth century, either through seeds sent home by the imperial envoy Ogier Ghislain de Busbecq, as most sources recount, or, possibly, through trade between Turkey and Italy, France, and the Low Countries. The first tulip in Europe was described by Conrad Gessner in *De Hortis Germaniae* (1561) as growing in 1559 in the garden of Johann Heinrich Herwart in Augsburg. By the late sixteenth century, botanists and collectors had developed a passion for tulips. Such collectors included both professional men with an interest in plants, particularly doctors and apothecaries, as well as a variety of elite groups ranging from merchants to aristocrats. The special excitement generated by tulips stemmed first from their foreign nature; they were prized along with the other exotic bulbs that arrived in Europe, largely from the Ottoman Empire, in the same period, including flowers such as the iris, crocus, and hyacinth.

But tulips were particularly valued because of their unpredictable and exciting capacities for variation. Unlike most other flowers, tulips could change from year to year in coloration and form, and the propagation of tulips could present new forms never before seen. Already in 1597 Gerard's *Herball* reported that to recount all the different sorts of tulips "would trouble the writer and weary the Reader," and by the time of Rea's *Flora* of 1665

we hear that "so numerous are the varieties, that it is not possible that any one person in the world should be able to express, or comprehend the half of them."[12] These qualities led to high prices for many tulips and, eventually, to a futures trade in the Netherlands. But even in countries unaffected by the futures trade, the tulip remained a favorite flower until it was eclipsed by the hyacinth in the eighteenth century.

Given the reigning issues about art and nature, the question of the authorship of tulip varieties was a live one in the period. Who or what actually created the tulip? Many works on gardening alluded to tulips, and to flowers in general, as small but perfect works of God, or of both God and nature. For Petrus Hondius, whose poem *Dapes Inemptae, of de Moufe-schans* (1614) praised the garden of his patrons in Neuzen, gardening was a way of honoring the name of God and his creation.[13] Similarly, Jean Franeau, extolling the gardens of the gentry and aristocracy of the Southern Netherlands, compared a flower to a school or a beautiful book of which "the author is this great God, who, as a schoolmaster, teaches the lessons in his own words."[14] But these protestations address a countervailing trend which we have already seen in the field of painting or sculpture: the desire of man to claim credit for himself. The commercial breeder Samuel Gilbert, acknowledging in 1682 that man can play a role in gardening, hedged his bets in a verse mainly devoted to the planning, shaping, and protection he would give to a garden:

> Assisting Nature by industrious Art;
> To perfect every Plant in every part,
> But not like some, whose crimes to rise so high
> Boldly to pull down Heavens Deity.[15]

Gilbert's concern that an emphasis on man deprives God of his rightful place speaks to the questions raised by those who believed that man could, indeed, "assist nature."[16]

The actual assistance man could provide was minimal, but this relative powerlessness was not acknowledged by contemporaries. We have seen that it was the variety of tulips that made them so popular. This variety was achieved either by cross-breeding or by "breaking" tulips through an aphid-borne virus. Neither process was known in the early modern period. Gardeners had no knowledge of the sexuality of plants, so that any crosses which occurred would have to take place by accident; and although there was some speculation that beautiful tulips were diseased—"in the same way that a person in agony turns different colors when through a contagious malady he approaches death," wrote a derisive La Chesnée Monstereul in 1654—this was neither universally accepted nor understood.[17] Yet long experimentation

had assured some botanists and gardeners that, if they were grown from seed rather than bulbs, certain tulips were more liable to vary in color, although such variation could take up to ten years. Jacques Garret, a Dutch apothecary living in London, was described by John Gerard as having "undertaken to finde out if it were possible, the infinite sorts by diligent sowing of their seedes, and by planting those of his owne propagation, and by others received from his friends beyond the seas, for the space of twentie yeeres, not being yet able to attaine to the end of his travaile, for that each new yeere bringeth foorth new plants of sundrie colors not before seene."[18] Later annotators of Dodonaeus's *Cruydt-Boeck* noted in 1618 that sowing seeds was an uncertain business, and that in any case tulips could get worse as well as better;[19] but the very fact that sowing seeds could produce new tulip strains produced a confidence that man could indeed use his art on the natural tulip.

Not surprisingly, much of the writing on the alteration of tulips focused on the choice of seed. If gardeners could not actually predict the outcome of sowing seed, at least they could try their art in choosing only the seed of superior tulips, and by culling bulbs of flowers that did not meet their standards. The eighteenth-century diary of the Lancashire gardening enthusiast Nicholas Blundell is full of notations such as "I Examain'd my Tulops and marked some of the best of them to be preserved & the worst to be destroyed."[20] But the idea that man could control nature went further than this. The aesthetic and commercial value of tulips, as well as the tedium of taking ten years to grow them from seed—described by the Haarlem breeder Nicolas van Kampen as "unpleasant" and "useless"[21]—led early on to more direct attempts to intervene by art into the processes of nature.

Some of these promised shortcuts to beautiful flowers, it is true, remained close to natural processes. The theory that tulips changed color through disease led to experiments in weakening flowers so that they would fall sick more easily. John Rea suggested in 1665, for example, that "more vulgar" tulips might be dug up just before flowering and laid in the sun "to abate their luxury, and cause them to come better marked the year following"; a yearly alternation of good and poor soil was thought to have the same effect.[22] Rea assured the aspirant gardener that such methods would produce tulips that "might be taken for much better flowers than they are, especially if a new name be put upon them, as some flower-merchants about *London* use to do."[23]

Other procedures to alter tulips, however, were much more self-consciously a form of art. Like an engraver carving designs on a nautilus shell, gardeners set about by intrusion to change their flowers. It was said that cutting two bulbs in half and sticking them together would produce a cross-breed; that new varieties of tulip with exotic colors could be bred by steeping the bulbs or seeds in colored water, ink, paint, or even "mixing a number of

ingredients with pigeon dung" and burning the ground with it.[24] Many of our accounts of such interventions come, it is true, from those casting aspersions on these methods; John Evelyn, for example, warns us to "trust little by mangonisme, insuccations, or medecine, to alter the species, or indeed the forms and shapes of flowers considerably," and John Parkinson dismisses as "meere tales and fables . . . the many rules and directions extant in manie mens writings to cause flowers to grow yellow, red, greene or white, that never were so naturally. . . . [W]hen they come to the triall, they all vanish away like smoak."[25] Comments of this sort indicate, however, the prevalence of such views; and contemporary gardening books, such as Giovanni Battista Ferrari's *Flora, seu de florum cultura* of 1633, took such advice seriously.[26] Moreover, even those ridiculing these methods did not necessarily believe that there was no art to changing the appearance of tulips. La Chesnée Monstereul, who took time to ridicule the Rouennais who burned up his entire garden with a fire made with pigeon dung, affirmed flatly that, although this particular method was laughable, efficacious means of producing new tulips did exist. "It only remains for me to discuss whether by Art one can embellish those which have not yet attained their peak of perfection. . . . I have no difficulty in saying that one can, and that without doubt by Art they can be rendered capable of changing into something better."[27]

Not only did gardeners, then, give their endorsement to the idea that man's art could triumph over the processes of nature, but they consciously conceived of what they were doing in these terms. La Chesnée Monstereul's discussion of the transformation of tulips plunges straight into the topic. "There is no doubt that it is not only in this point that Art surpasses nature, of which we can see the effects, but in many other things which [Nature] begins, & which Men complete & perfect through their industry."[28] Florists and gardeners, according to other writers, "know how to aid nature by an artifice which industry and time has taught them"; flowers are "natures Choicest dishes, advantag'd by Art."[29] These gardeners were not mere spectators to the wonders of nature, but active participants in changing it, for, as Jan van der Groen wrote of gardens in 1669, "nature can, through art, be shifted, decorated, put into good order, and made ornamental and pleasurable."[30]

Thus even those pleading, as Samuel Gilbert did with such concern, that flowers were the work of God had to admit that, ultimately, "our Art, with Madam Nature joyn[s]."[31] But the power to control nature—a power of which tulips were, ironically, a poorer example than industry or agriculture—was not the end of the construction of tulips as artifacts. The language used by gardening writers and the names given to tulips by growers show a distinct mental association between the flowers and both art and craft. In floral still life, it was said that the technically gifted made roses look

like silk and tulips like leather,[32] but the same kind of comparisons were applied not only to paintings but to the flowers themselves.

The trope that tulips outdid the work of any painter—"it is impossible for painters and dyers to imitate the colors of them"[33]—demonstrates a cognitive link between the flowers and the art of painting. But the mention of "dyers" in this same passage from a 1697 gardening treatise points us toward the wider associations of tulips in the period. There were constant references to the flowers as part of a wider world of man-made luxury objects. That both paintings and other *artificialia* should provide comparisons with tulips is perhaps not surprising, since painting had such strong connections with craft and with craft guilds, in the Netherlands at least. In the chief towns of Holland, painters and sculptors were members of the same guild as craftsmen such as embroiderers, glassworkers, and goldsmiths. Although painters increasingly came to emphasize the dignity of their profession, they did not seek in this period to emancipate themselves from the structure of a craft guild; indeed one artist who also was involved in the tulip trade, Frans Pietersz. de Grebber, was reported to "get by nicely on embroidery" when his skills as a portraitist were not in demand.[34] Given both the rarity and the price of tulips, however, a more important explanation for their linkage with costly crafts is surely the role of the luxury trades in the maintenance of status. Like visible material wealth, tulips were precious and costly collector's items. The close associations of tulips and luxury are evident; the names and descriptions of tulips remind us continually of a shiny, varied, patterned world of cloth, enamel work, and polished stone.

Cloth, carpets, and embroidery are among the earliest images applied to tulips and the gardens containing them. Gardens decorated with a variety of colors reminded viewers of a tapestry or carpet; Marie de Brimeu, Princesse de Chimay and a friend of Clusius', referred in 1591 to the garden he had stocked for her with plants sent from Frankfurt as "the riches of your tapestries [which] truly surpass by far those of gold & silk, as nature surpasses artifice."[35] John Parkinson was still musing in 1629 on such comparisons, and on the possibilities for garden design using tulips. "[A]bove and beyond all others, the Tulipas may be so matched, one colour answering and setting of another, that the place where they stand may resemble a peece of curious needle-worke, or peece of painting."[36] That this was not merely a metaphor is evident from the *Iardin du Roy Tres Chrestien Henry IV* of 1608, a collection of engravings of plants in the king's gardens. The author, Vallet, far from being a gardener, was a professional embroiderer, and the accompanying verses in praise of the book make much of his abilities with the needle. His designs were evidently intended at least in part as patterns for embroidery.[37]

Not only whole flower beds, but also individual tulips called to mind the luxury of elegant cloth. Clusius, in first describing his tulips in his *Rariorum*

plantarum historia, resorted repeatedly to images of silk shimmering with two colors, such as a silk with a golden warp and a red weft, or a silver silk, made in the same way and known to the Germans as Silberfarb.[38] Such images quickly appeared in the vernacular. Among the earliest names to be given to tulips (the first flowers of which individual cultivars were named) were "Goude Laeckens" and "Silver Laeckens," gold cloth and silver cloth, appearing in other countries as "drap d'or" and "drap d'argent" and as "Cloth of golde" and "Cloth of sylver."[39] Other names referring to cloth included "Saey-blom" (say-flower). While says were not the most elegant of cloths, the economy of Holland depended on them; and the other materials could not have been more redolent of luxury. No cloth was more expensive or prized than silk embroidered or shot with gold or silver thread—silver tissue was the standard material of bridal gowns at the European courts[40]—and silk and satin clothing was similarly confined to the elite.[41] Like embroidery, which bespoke an ability to pay for goods whose manufacture was highly labor-intensive, clothing or furnishings made of costly materials were effective signals of leisure and high station. Fine textiles, because they demonstrated marvelous workmanship, were also commonly to be found in collections and *Kunstkammern*.[42]

It was natural for an expensive flower like the tulip to be compared with such goods, but, as Clusius's more specific descriptions indicate, it was not an idle comparison. The petals of the tulip were also thought actually to resemble silk, satin, or velvet. One Dutch gardening book recommends matter-of-factly that a good source of seed for the best tulips was a flower that was "Satijn-agtig" (satinlike),[43] and in the more florid prose of works dedicated to praising the tulip, references to elegant cloth abound. To take only one example, Jean Franeau's 1616 ode to the tulip, the *Iardin d'Hyver ou Cabinet des Fleurs*, intended to remind the growers and collectors of the aristocracy and gentry in the Southern Netherlands of their treasures during the winter months, is liberally peppered with references to embroidery, silk, taffeta, silver cloth, and silver needlework. Tulips were "dressed" in rich "mantles" which, far from being natural, were "full of artifice." The tulip called the Duc van Tholl was said to be the work of a skilled tailor: clothing worthy of a great prince or duke, so richly was it embroidered in gold. This was the work of nature, Franeau wrote, but also of "les grans," who cultivated tulips in their gardens.[44]

The luster of tulips, if it did not come from shiny satin or silk, was also said in many texts to be enamel work or vermeil, a metaphor that was mixed happily with the many references to clothing.[45] But the other favorite comparison for the tulip, with its veined and streaky markings, was polished stone such as marble and agate. Again, the names of tulips give us a hint of how they were perceived. A common designation in the Netherlands was

ghemarmerde, marbled, and names such as Ghemarmerde de Goyer or Ghemarmerde Liefkens became usual. In French, tulips were "marbrées" or "jaspées," and whole classifications of tulips based on this comparison grew up. Besides the Morillons, or rough emeralds, a major class of French tulips (which was adopted also in English nomenclature) was the Agate. By mid-century there was an abundance of names such as Agate Morin, Agate Guerin, or Agate Picot, generally adding the name of the cultivator to the designation of Agate; La Chesnée Monstereul mentioned fifty-five Agate tulips in his list of 1654.[46] John Rea gives us a good picture of the association of the two objects; tulip petals, "warmed by the Sun, open and change into divers several glorious colours, variously mixed, edged, striped, feathered, garded, agotted, marbled, flaked, or speeled, even to admiration."[47] Like tulips, stones such as agates and marbles were prized for their variation in color and their attractive veining. Polished and worked, they formed an ornament to buildings, were transformed into *pietra dura* furniture, or formed objects for the *Kunstkammer* or cabinet. We find special collections of agates in the period, such as that belonging to the goldsmith Antoine Agard of Arles, not to mention the agates and marbles in the cabinets of tulip lovers such as Christiaan Porret in Leiden or Bernardus Paludanus in Enkhuizen.[48]

The designation of tulips as *ghemarmerde*, *marbré*, or "marbled"—phrased as though they had actually undergone a process—raises, moreover, the possibility that the connection was actually with marbled paper rather than marble itself. Paper with the swirling patterns of marble had arrived in Europe around the same time as the tulip and from the same country of origin, and, like tulips, it became associated with the Dutch in the seventeenth century. Like real agates, marbled paper was valued by collectors and can be found in collections, such as that of Paludanus; Pierre de l'Estoile records instances in 1608–09 of giving a fellow Parisian collector sheets of marbled paper because "I know he is a collector like myself."[49] The resemblance between the paper and stone was remarked upon early, and one of the oldest patterns was known, like the tulip, as Agate.[50] Interestingly, Evelyn uses the word "Pennaches (as the French call it)" to describe the paper's design;[51] *panache* was the usual word for the similar patterns on tulip petals, with a broken tulip being known as *panachée*. Most suggestively, Anna Maria von Heusenstain, who frequently wrote Clusius from Vienna asking for flowers, reported in 1591 that a tulip she still lacked was called "Turkish paper" ("das tirckisch papir").[52] Although we cannot be conclusive about the connections between marbled paper and tulips, it is clear, at least, that all these objects—flower, paper, and stone—occupied a similar space of aesthetic appreciation and social and intellectual exchange.

The praise of the tulip, indeed, is reminiscent of the kind of aesthetic discussion we find about paintings in the same period. Although the Dutch

were, as Seymour Slive has put it, "unusually inarticulate" about their art in the seventeenth century,[53] with only a handful of critical writings to help us enter the minds of artists, the same sorts of words to describe beauty (*aerdigh*, *fraey*, *schoon*) and the same values of harmony of form and clear, bright colors were applied both by a writer on painting like Karel van Mander in 1604 and commentators on the beauty of tulips.[54] Both annotations to Dodonaeus' chapter on tulips and Karel van Mander on paintings, for example, spoke of *netticheyt*, the engagement of the eye, in the case of painting in a smooth rendering of surface; the tulip was said to be "much honored in all lands for the *netticheyt* of its petals."[55] But perhaps the most important aesthetic comment common both to tulips and art was the value of *verscheydenheydt*: variety. The excitement of diversity dated back at least to Pliny,[56] and formed an important principle for a range of arts in the Renaissance, from painting to music to literature.[57] For Karel van Mander it was a crucial concept; art should found itself on nature, and "nature is beautiful through variety," both the variety of colors and of forms and attitudes.[58] He compared a painting with a field of flowers which draws the eye, like the honeybee, to dart from one point to another, eager not to miss any of the sweetness.[59] And as we have already seen, it was the variation of tulips, from year to year, from mother bulb to offset, from bloom to bloom, which made tulips so much more compelling than other flowers: "the more various, the more beautiful."[60] Again, the appreciation of tulips falls within the same aesthetic universe as the appreciation of art.

While these similarities might be put down to the paucity of critical language available to commentators, the very fact that a critical vocabulary was being applied to tulips at all demonstrates another facet of their relationship to works of art. In a period when critical discussion and connoisseurship of painting among laymen was becoming more common, alongside the rise of the virtuoso collector of *artificialia*, we also find an increasing application of specific standards to tulips.[61] Whereas in the late sixteenth and early seventeenth century writers were relatively undiscriminating about tulips, finding all a source of wonder, it did not take long for writers and enthusiasts to develop a hierarchy of varieties and a set of characteristics of a good flower. In a typical case, Peiresc complained in 1626 of seven or eight boxes of tulips he had received from his brother's estate: "I found none which were perfect of their sort. The *drap d'or* and *drap* or *toille d'argent* had so much red in them that the rest seemed nothing of any worth."[62] In guides for gardeners, some of whom might not know "either what to choose, or what to desire," as Parkinson put it, we find descriptions of the best tulips; La Chesnée Monstereul provided a chapter with the title "What the Tulip must be, both in its Colors, Panaches, and in its Form," and similarly Valnay and Van Kampen each spent some pages outlining such qualities.[63] Valnay instructed his read-

ers that the most beautiful tulips were the "bigeares" (stripes of brown, red, violet, or other colors on a yellow background), the more nuanced the better, and the stripes or panaches had to be distinct; the colors should be as far from red as possible, although "red ones on a white ground are not to be rejected." He defined the proper form of the flower, a description of the best color for the base, and the appropriate size and color of the stamens.[64] Some of these standards might be thought to be fixed, as they resulted from observation of the best traits for breeding. Since the purpose of breeding was beauty, however, the apparent "science" of such definitions in fact demonstrates how the changing vision of floral excellence was an arbitrary matter of aesthetics. And that the standards changed over time links tulips not only to painting but also back to clothing and fashion. Rea, in 1665, remarked that the flowers described by Parkinson in 1629 had "by Time grown stale, and for Unworthiness turned out of every good Garden"; the popular flowers in his day, tellingly, were known as Modes.[65] But for a certain core of tulip lovers whom we can consider the connoisseurs, the standards hardened into what would ultimately be called "florists' flowers," with the specific requirements for shape, texture, color, and markings enforced by the development of flower shows in the eighteenth and nineteenth centuries.[66]

That the resemblance of tulips to art could extend to connoisseurship has important implications. As we have seen, the idea that art and nature were potentially oppositional is something of a cliché. So, indeed, is the suggestion that the line between these two could become blurred in the early modern period. Scholars who have written on these subjects have also approached them by commenting on artistic objects that look like nature (Palissy's ceramics) or natural objects that look like art (figured stones with apparent landscapes or animals in their markings). But with tulips, as I have argued, the tulip itself is objectified. Although the tulip resembled works of art, it did not have to, since it was in fact art itself, an item that, it was thought, could be created in its entirety by man. Moreover, once made, the tulip was the subject of criticism and discussion. Thus not only was the tulip a real art form, but it was an art that had further ramifications. The tulip as art promoted sociability.

From the beginning, the increasing interest in exotic flowers, of which tulips were the chief, fit into existing exchange relationships and engendered new ones. Dodonaeus made it clear in his *Cruydt-Boeck* that in the Low Countries the tulip was "only to be found in the gardens of the connoisseurs [*liefhebbers*],"[67] and it is evident that many of these connoisseurs knew each other and exchanged flowers. The botanist Carolus Clusius is an obvious example; his correspondence includes much evidence of the trading of bulbs and seeds, even with people he had never met.[68] Less professional plant-lovers, such as Petrus Hondius, also clearly were involved both in the breed-

ing of tulips and their exchange, and similar relationships are also obvious among collectors in other countries. Peiresc, for example, reported sending tulips to Antelmy, *conseiller* at the Parlement at Aix; Sir Thomas Hanmer's correspondence shows him sending "rootes" to friends such as John Evelyn and the parliamentary general Lord Lambert; while the anonymous accounts of an English garden from 1638–39 included both bulbs sold by the owner to "Mrs Rous" and a large number exchanged with a "Mr Blackley" and a "Mr La candle": "Amanicis de Pari for Olivandesburge/Generall Gouda for Noris morilio[n]/Satanee for Gulamp van Rhine/Mr Jullien for Semp[er] Londinu[s]."[69] Such relationships could become institutionalized in clubs such as the Society of Florists of Norwich, known to have existed since at least 1631, when Ralph Knevet's play *Rhodron and Iris: A Pastorall* was presented at their feast on the third of May.[70] Such florists were not professional growers—the word came to that meaning only later—but rather were lovers of flowers who grew them for their beauty rather than any usefulness.[71]

Whether or not tulip lovers were involved in formal societies, tulips became a route of sociability for them. Because of their bulbs, John Rea wrote in 1665, tulips could be regarded as "transferable favours from one *Florist* to another, aptly conveyable (the seasons considered) many miles distant."[72] The fellow feeling that was engendered by these exchange relationships was an important part of the interest in tulips. La Chesnée Monstereul devoted a chapter of his treatise on the flowers to pleading that tulips should not be allowed into the hands of the many. "If Tulips were made common, that would remove the most praiseworthy interaction to be found among Men, & would deprive them of the most sweet society which has ever existed among *gens d'honneur*. How much company does their rarity give to curious wits? how many agreeable visits? how many sweet conversations? & how many well-founded discussions? Certainly this is the sweetest life in the world."[73] Such interchange could be the foundation both of society and of a good collection, so that the anonymous Valnay could write of himself that "through purchases, exchanges, and accommodations, the principal stock of the only beautiful Tulips are at present in the hands of M. de Valnay" and two other persons, all officers at the Louis XIV's court.[74] In his pursuit of the tulip, someone like Valnay, breeder and *curieux*, was both artist and collector.

Valnay listed only a few *curieux* and breeders in Paris who had experimented on tulips, attempting to get more beautiful varieties as they studied each other's productions. But the best flowers remained rare, and, according to his account, one seventeenth-century collector, Lombard, who had the best stock, would not exchange or sell any of his bulbs or seed, "which increased the desire [for them] and the price."[75] La Chesnée Monstereul's argument that tulips should remain confined to a few is important to the status of these flowers as collectibles or as art. The sociability of connoisseur-

ship is based on expertise about the rare and costly; if everyone could comment, or everyone could own these objects, there would be no point to the connoisseurship. Thus although he declared that it was possible to change tulips by art—in his case, essentially alchemy—he would not reveal the formula. "I do not want the secrets of Divinity to be known other than by Sages, so that they are not profaned by the vulgar; it being a certain thing, that according to the sentiment of the learned [Roger] Bacon, he who reveals the Mystical diminishes & reduces its majesty." He provided a mysterious and cryptic recipe, saying "those who have eyes & ears will see & hear"; no one without the requisite learning would be able to understand his formula and thus join the exalted company of the artists and the connoisseurs.[76]

But the similarity between tulip lovers and collectors of art and curiosities does not end with the behaviors of connoisseurship and exchange. In many cases, these groups did not simply resemble each other, but were actually the same. Tulip buyers were themselves collectors of art. Pierre Morin, one of the great professional florists of the first half of the century, was also "one of the most intelligent men in the world in all these rarities," including objects of art as well as shells, butterflies, and other *naturalia*.[77] But ordinary buyers of bulbs, or owners of a few tulips, prove on investigation to have been active in the purchase of artworks. A comparison of the names of tulip buyers in Amsterdam up to 1640 with those known to have bought art at auction suggests that, in Amsterdam at least,[78] among the main groups to take an interest in tulips in the period were members of overlapping networks of art collectors. The merchant Abraham de Casteleyn, for example, was involved in both breeding and purchasing tulips, but also bought art at auction and was a considerable collector of *naturalia* and *artificialia*. At his death in 1644 he left not only his cabinet of curiosities, but a carefully arranged collection of tulip bulbs whose inventory ran to thirty-nine pages.[79] Similarly, men such as Lambert Massa, Adam Bessels, Jacob Abrahamsz. van Halmael, and Jan Hendricksz. Admirael, who were mainly merchants, purchased paintings and prints at auction and even (in the case of Massa and Bessels) were connected to important families of art patrons, but were also involved in the purchase of tulip bulbs.[80] These are only some of the examples of the crossover between tulip and art collectors in Amsterdam in the first part of the seventeenth century.

The fact that many of these transactions took place during the financial craze of 1634–37 of course raises questions about the role of commerce in this relationship between tulips and art. It is hard to determine exactly why people bought tulips, even if they were collectors of art; and of course there is a commercial element even to collecting, however much the values of exchange and civility also entered into it. For tulips or for paintings, the question remains whether the reason for purchase was decoration, collect-

ing, or profit.[81] The remark of Valnay's cited above, pointing to the increased desirability of rare tulips in Paris precisely *because* they were rare, reminds us that commerce was a factor in the love of "artistic" tulips from the beginning. Clusius, involved in exchange relationships with botanists, apothecaries, and scholars across Europe, disapproved of the commercial activities of the "rhizotomi" (root cutters), his name for the (mainly French) traveling sellers of bulbs and exotic plants, at the same time as he made purchases from them. One of his arguments was that of connoisseurship. Whereas he had always maintained a garden to supply his friends, now, in 1594, "merchants, even tailors and shoemakers and other petty people are involved, through the hope of profit. For they see that rich people will sometimes give out handfuls of money to buy some plant or other which is sought because of its rarity, so that they can preen themselves in front of their friends because they own it."[82] The implication is that exchange, not purchase, is the proper way to obtain bulbs, and that those appropriate to own such bulbs should remain select. But it is evident that, well before the speculative craze of the 1630s, beauty was in the eye of the purchaser. Commentators on Dodonaeus wrote in 1618: "In this country men love most the flamed, winged, speckled, jagged, or snipped and the most strongly variegated: and they will pay the most, not for the most beautiful or the finest, but for the rarest to be found, or those owned by only one master; these can fetch high prices."[83] And Rea's remarks in 1665, quoted above, that alternating soil can make "vulgar" tulips appear "better flowers than they are, especially if a new name be put on them," reminded the reader of a commercial advantage to the application of art.[84]

These comments point us both to the tulipmania of the 1630s and beyond. As trade in tulips heated up, some buyers, at least, wanted whatever would command the highest price. The fact that by this time some tulips were sold as futures and could change hands several times before they came to flower makes it plain that at this juncture tulips were valued by some only for their profitability. But the emphasis of the *Cruydt-Boeck* on beautiful features as well as on the price that rarity brings reminds us that beauty and profit can go hand in hand. After the crash in February 1637, tulips continued to be a favorite flower and continued to command good prices. Indeed, the consolidation of the bulb-growing industry around Haarlem dates from the period after 1637, with dynasties of commercial growers settling into what until then had been sometimes a temporary or part-time occupation. The scion of one such dynasty, George Voorhelm, was in 1752 still making arguments from connoisseurship to justify his high prices for hyacinths, by then the flower of mode.

> Is not a unique Hyacinth, which twenty or thirty people have been trying in vain to cultivate, a wonderful thing? Should not he who possesses it be

> pleased with himself? Is it not very satisfying to be able to say: there are several people in my town who have magnificent Diamonds, but no one in the world who has a flower as beautiful as mine? Does not such a Flower have a real value? Is one not obliged to make more of it than of a thousand other Flowers? Could one be such an idiot as to offer it for nothing? . . . Why should one make a fuss if it is sold for a thousand Florins?[85]

Rarity, beauty, and profit thus go together; what is rare is beautiful, and what is beautiful is profitable. This is the reason for the constant changes in the fashion of flowers, for once a particular tulip is cultivated too widely, it becomes "obsolete and overdated" and must be replaced by others now claimed to be more beautiful.[86] The ultimate result, for the tulip, was the rise of the hyacinth.

The rhetoric of florists thus has considerable resonance for the commercial world. If supplies were too great, then tulips would lose their value; tulips must therefore not become common. New techniques had to be tried, and new flowers grown, if tulips were to remain profitable for those investing their time and money. As in a craft guild, the "mysteries" of the craft had to be protected, although, ironically, of course, in this case there was no proven art of creating new tulips. Such techniques as were developed were aimed to cut the cost and labor involved in production; to turn out new varieties, breeders did not want to have to wait eight or ten years to see the uncertain results of their culled seed. The interest in tulips, their praise, their production, thus all owed at least some of their impetus to commerce. But, as students of the art market have noted, such arguments can apply equally well to painting.[87]

Nicolas de Valnay, by arguing that tulips were superior to other works of art, chose to situate the flower in the milieu of aesthetics, artistic creation, collecting, and connoisseurship. In the long-standing argument over the superiority of art or nature, he chose nature; but this nature, for him and his colleagues, in fact *was* art. The apparent creation of their artwork, their knowledge of it, their criticism, all, Valnay would say, gave them rights to challenge the Académie de Peinture. And, as the comparison with the academy suggests, there were social ramifications for this identification of nature with art. Connoisseurship and collecting established social networks, to be institutionalized ultimately in florists' societies and flower shows. The commercial craze for tulips in the 1630s, with its concentration solely on profit, is something of a diversion from these trends, but not entirely. For tulips, as for other collectibles, commerce was always a part of the equation. La Chesnée Monstereul might protest that "well bred spirits have beauty rather than mercenary advantage as their object,"[88] but with tulips so expensive, the line between beauty and profit could blur. Perhaps Paul Contant, apothecary of

Poitiers, was more honest with himself. His cabinet and his garden were open to visitors; but he charged them admission.[89]

Notes

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1. [Nicolas de Valnay], *Connoissance et culture parfaite des tulippes rares, des anemones extraordinaires, des oeillets fins, et des belles oreilles d'ours panachées* (Paris: Laurent d'Houry, 1688; first published 1669), "Avertissement." The book is attributed to Valnay by E. H. Krelage, *Drie Eeuwen Bloembollenexport* (The Hague: Rijksuitgeverij, 1946), 538, and Antoine Schnapper, *Le Géant, la licorne, la tulipe: Collections et collectionneurs dans la France du XVIIe siècle* (Paris: Flammarion, 1988), 44.

2. [Valnay], *Connoissance et culture parfaite*, "Avertissement."

3. Lorraine Daston and Katharine Park, *Wonders and the Order of Nature 1150–1750* (New York: Zone Books, 1998), chap. 7.

4. For Zeuxis, see Pliny, *Natural History* xxxv. xxxvi. 64–66.

5. These views are much discussed in the literature, but see, among others, Erwin Panofsky, *Idea: A Concept in Art Theory* trans. Joseph J. S. Peake (New York: Harper & Row, 1968, first published 1924), 48; Ernst Kantorowicz, "The Sovereignty of the Artist: A Note on Legal Maxims and Renaissance Theories of Art," in *De Artibus Opuscula XL: Essays in Honor of Erwin Panofsky*, ed. Milliard Meiss (New York: NYU Press, 1961) I, 268, 271; Joy Kenseth, "The Age of the Marvelous: An Introduction," in *The Age of the Marvelous*, ed. Joy Kenseth (ex. cat. Hood Museum of Art, Dartmouth College, 1991), 38; Walter Melion, *Shaping the Netherlandish Canon: Karel van Mander's Schilder-Boeck* (Chicago: University of Chicago Press, 1991), 20–21.

6. Beatrijs Brenninkmeijer-De Rooij, "For the Love of Flora: A Brief Look at Seventeenth-Century Flower Painters," in Brenninkmeijer-De Rooij et al., *Boeketten uit de Gouden Eeuw/Bouquets from the Golden Age: The Mauritshuis in Bloom* (ex. cat. The Hague, Mauritshuis, 1992), 14; Paul Taylor, *Dutch Flower Painting 1600–1720* (New Haven, Conn.: Yale University Press, 1995), 82–83.

7. Constantijn Huygens, "In praestantissimi pictoris Dan. Segheri rosas," in *A Selection of the Poems of Sir Constantijn Huygens (1596–1687)* ed. and trans. Peter Davidson and Adriaan van der Weel, (Amsterdam: Amsterdam University Press, 1996), 129.

8. John Rea, "Flora, To the Ladies." *Flora, seu, De Florum Cultura* (London: for Richard Marriott, 1665). See also Samuel Gilbert, *The Florists Vade-Mecum* (London: for Thomas Simmons, 1682), 87, who versified on tulips: "Presuming Painters find their skil out-done\At sight of these, so Pensil'd by the Sun, That *Paterzeger*, doth himself confess\He colours wants their glories to express."

9. Daston and Park, *Wonders*, 255–260, 276–277; Martin Kemp, "'Wrought by No Artist's Hand': The Natural, the Artificial, the Exotic, and the Scientific in Some Artifacts from the

Renaissance," in *Reframing the Renaissance: Visual Culture in Europe and Latin America 1450–1650*, ed. Claire Farago (New Haven, Conn.: Yale University Press, 1995), pp. 177–196.

10. On Palissy, see Daston and Park, *Wonders*, 285–286, and Kemp, "'Wrought,'" 191–193. On naturalistic automata in gardens, see John Dixon Hunt, "'*Curiosities* to Adorn *Cabinets* and *Gardens*,'" in *The Origins of Museums*, ed. Oliver Impey and Arthur MacGregor, (Oxford: Clarendon Press, 1985), 198–200.

11. Kemp's article, "'Wrought,'" focuses entirely on such objects. On coconuts, see especially Rolf Fritz, *Die Gefässe aus Kokosnuss in Mitteleuropa 1250–1800* (Mainz am Rhein: Verlag Philipp von Zabern, 1983). On ostrich eggs, see Isa Ragusa, "The Egg Reopened," *Art Bulletin* 53 (1971): 435–443, and Creighton Gilbert, "'The Egg Reopened' Again," *Art Bulletin* 56 (1974): 252–258. Numerous such objects are pictured in *Prag um 1600: Kunst und Kultur am Hofe Rudolfs II.* (ex. cat. Essen, 1988); see, e.g., color plates 68, 69, 71, 72.

12. John Gerard, *The Herball or Generall Historie of Plantes* (London: John Norton, 1597), 119; Rea, *Flora* (1665), 50.

13. Petrus Hondius, *Dapes indemptae, of de Moufe-schans/dat is, De soeticheyd Des Buyten-Levens, Vergheselschapt met de Boucken* (1614), (Leiden: Daniel Goels, 1621; orig. ed. 1614), 88–89, 93.

14. Jean Franeau, *Iardin d'Hyver ou Cabinet des Fleurs* (Douai: Pierre Borremans, 1616), Elegie xxvi, 2. Pagination starts over with this elegy.

15. Gilbert, *Florists Vade Mecum* (1682), 12.

16. Gilbert's concern was not only with man's arrogance, but also with those who divided nature from God; he wished "that men may make each Clod/Speak God of Nature, make not Nature God" (ibid., 13). Such comments, besides worrying about the role of man, point to the sort of concerns with the relationship between God and nature in the later seventeenth century discussed by Daston and Park (*Wonders*, 296–301).

17. Sieur de La Chesnée Monstereul, *Le floriste françois, Traittant de l'origine des Tulipes* (Caen: Eleazar Mangeant, 1654),72; Ruth Duthie, *Florists' Flowers and Societies* (Haverfordwest: C.I. Thomas and Sons, 1988), 7–8; Krelage, *Drie Eeuwen Bloembollenexport*, 458; Elisabeth Blair MacDougall, "A Cardinal's Bulb Garden: A *Giardino Segreto* at the Palazzo Barberini in Rome," in MacDougall, *Fountains, Statues, and Flowers: Studies in Italian Gardens of the Sixteenth and Seventeenth Centuries* (Washington D.C.: Dumbarton Oaks Research Library and Collection, 1994), 241 n. 58.

18. Gerard, *Herball* (1597), 117.

19. In Rembertus Dodonaeus, *Cruydt-Boeck* (Leiden: François van Ravelingen, 1618), 367, "Biivoegsel."

20. Frank Tyrer, ed., *The Great Diurnal of Nicholas Blundell of Little Crosby, Lancashire* II, Record Society of Lancashire and Cheshire 114 (1972), 55, 28 April 1726.

21. Nicolas van Kampen, *Traité des Fleurs à Oignons* (Haarlem: C. Bohn, 1760), 71.

22. Rea, *Flora* (1665), 70–72; Gilbert, *Florists Vade-Mecum* (1682), 81–82, 85, and Van Kampen, *Traité des Fleurs à Oignon* (1760), 58–59, also recommend alternating soil or using poor soil to weaken bulbs.

23. Rea, *Flora* (1665), 71.

24. See for discussions of such methods Hanmer, *Garden Book* (1659), 17; Van Kampen, *Traité des Fleurs à Oignons* (1760), 58–59; La Chesnée Monstereul, *Le floriste françois* (1654), 175–176.

25. John Evelyn, *Kalendarium Hortense*, ed. Rosemary Verey (London: Stourton Press, 1983; first published 1664); Parkinson, *Paradisi* (1629), 23.

26. Giovanni Battista Ferrari, *Flora, seu de florum cultura libri IV* (Rome, 1633), 457–503, cited in MacDougall, "A Cardinal's Bulb Garden," 241.

27. La Chesnée Monstereul, *Le floriste françois* (1654), 163–164.

28. Ibid., 164.

29. *Nouvelle instruction pour la culture des fleurs* (Amsterdam: Henri Desbordes, 1697), 120; Gilbert, *Florists Vade-Mecum* (1682), "To the Reader."

30. Jan van der Groen, *Den Nederlantsen Hovenier* (Amsterdam: Weduwe van Gijsbert de Groot, 1721; orig. ed. 1669), "Inleydingh."

31. Gilbert, *Florists Vade-Mecum* (1682), 251.

32. Brenninkmeijer–De Rooij, "For Love of Flora," 14.

33. *Nouvelle Instruction pour la Culture des Fleurs* (Amsterdam: Henri Desbordes, 1697), 120.

34. See Hessel Miedema, "De St. Lucasgilden van Haarlem en Delft in de zestiende eeuw," *Oud Holland* 99, no. 2 (1985): 77–109; Miedema, "Kunstschilders, gilde en academie: Over het probleem van de emancipatie van de kunstschilders in de Noordelijke Nederlanden van de 16de en 17de eeuw," *Oud Holland* 101, no. 1 (1987): 1–34; Svetlana Alpers, *The Art of Describing: Dutch Art in the Seventeenth Century* (Chicago: University of Chicago Press, 1983), 100, 102; Celeste Brusati, "Stilled Lives: Self-Portraiture and Self-Reflection in Seventeenth-Century Netherlandish Still-Life Painting," *Simiolus* 20, nos. 2/3 (1990/1991): 171. On embroiderers in the St. Lucasgilde, see Saskia de Bodt, . . . *op de Raempte off mette Brodse: Nederlandse Borduurwerk uit de Zeventiende Eeuw* (Haarlem: H. Becht, 1987), 22–36. The comment on Frans Pietersz. de Grebber appears in Karel van Mander's *Schilder-boeck*; the best edition is Karel van Mander, *The Lives of the Illustrious Netherlandish and German Painters, from the first edition of the Schilder-boeck (1603–4)*, ed. and trans. Hessel Miedema (Doornspijk: Davaco, 1994), Vol. 1, f. 300 of facsimile.

35. University of Leiden (UBL), Ms. Vulc. 101, Marie de Brimeu, princesse de Chimay, to Carolus Clusius, letter 2, Leiden, 18 September 1591. *Tapisseries*, the word used here, seems to have been a usual metaphor of hers for gardens; in other letters she describes the garden she lost by moving to the north as "des belles tapisseries que jay perdu pendant ces troubles" (UBL, Ms. Vulc. 101, Marie de Brimeu to Clusius, letter 3, Leiden, 24 January 1592) and remarks that "combien q[ue] naves moien de dresser vostre tapiserÿe tellem[ent] que desireries ie ne doute que nonobstant ce elle serat tres belle" (UBL, Ms. BPL 885, Marie de Brimeu to Clusius, The Hague, 5 November 1593). That it was a more general comparison is suggested by the verb *se tapisser* used by Christiaan Porret to describe his garden: "Mon iardin commence a se tapisse[r] de petites fleurs" (UBL, Ms. BPL 2724d, Christiaan Porret to Matteo Caccini, 25 February 1611). This comparison with carpets is also discussed in Erik de Jong and Marleen Dominicus-van Soet, *Aardse Paradijzen: De tuin in de Nederlandse kunst, 15de tot 18de eeuw* (ex. cat. Haarlem, Frans Halsmuseum, 1996), 103, and MacDougall, "A Cardinal's Bulb Garden," 233.

36. Parkinson, *Paradisi* (1629), 14.

37. Pierre Vallet, *Le Iardin du Roy Tres Chrestien Henry IV Roy de France et de Navare* ([Paris]: 1608). See also Penelope Hobhouse, *Plants in Garden History* (London: Pavilion Books, 1992), 108.

38. Carolus Clusius, *Rariorum plantarum historia* (Antwerp: Plantin, 1601), II, cap. IX, sec. III, pt. 2,146; cap. VII, sec. VII, pt. 8,142.

39. The earliest use of these names I have found is 1592, when the tulip-lover Jan van Hoghelande in Leiden reported the flowering of "une [tulipe] de drap d'or fort belle" in his garden (UBL, Vulc. 101, Jan van Hoghelande to Clusius, letter 7, 20 May 1592 N.S.). The earliest I have found in Dutch is in Emmanuel Sweerts, *Florilegium* (Frankfurt am Main: Anthonius Kempner, 1612), "Catalogus den ersten Boeck," in which the "*Tulipa* geel met fleyne roode strepen/genaempt goude Laecken" stands out among a host of mere descriptions of flowers; in the French section of the tetralingual *Florilegium* it is merely called "d'orée," as a description, and the name also does not appear in the German and Latin sections. The minister Walter Stonehouse had both "Cloth of golde" and "Cloth of sylver" in his garden in

Yorkshire in 1640 ("The Garden of the Rev. Walter Stonehouse at Darfield Rectory in Yorkshire," *The Gardeners' Chronicle*, 29 May 1920, 268), and La Chesnée Monstereul's long catalog of tulips in 1654 includes four types of "Drap d'argent" (*Floriste françois*, 224). Annotators of Dodonaeus's *Cruydt-Boeck* (1618 ed.) made the same comparisons: "sometimes one color shines above the other: that is the white and the yellow have something red shining through it: one like gold cloth/one like silver cloth" (*Cruydt-Boeck* [1618], 365).

40. Irene Groeneweg, "Court and City: Dress in the Age of Frederik Hendrik and Amalia," in *Princely Display: The Court of Frederik Hendrik of Orange and Amalia van Solms in The Hague*, ed. Marika Keblusek and Jori Zijlmans, (ex. cat, The Hague, Haags Historisch Museum, 1997), 203.

41. Linda A. Stone-Ferrier, *Images of Textiles: The Weave of Seventeenth-Century Dutch Art and Society* (Ann Arbor: UMI Research Press, 1985), 172, 215–216; Groeneweg, "Court and City," 201–203, 205–206; Valerie Cumming, "'Great vanity and excesse in Apparell': Some Clothing and Furs of Tudor and Stuart Royalty," in *The Late King's Goods: Collections, Possessions and Patronage of Charles I in the Light of the Commonwealth Sale Inventories*, ed. Arthur MacGregor (London and Oxford: Alistair McAlpine/Oxford University Press, 1989), 322, 326; Donald King, "Textile Furnishings," in MacGregor, *The Late King's Goods*, 307–308; Alison McNeil Kettering, "Ter Borch's Ladies in Satin," in *Looking at Seventeenth-Century Dutch Art: Realism Reconsidered*, ed. Wayne Franits (Cambridge: Cambridge University Press, 1997),103–4. On the Leiden say industry, see Leo Noordegraaf, "The New Draperies in the Northern Netherlands, 1500–1800," in *The New Draperies in the Low Countries and England*, ed. Negley B. Harte (Oxford: Oxford University Press, 1997), 173–195, and Stone-Ferrier, *Images of Textiles*, 23–29; on the Amsterdam silk and silver cloth industries, see Leonie van Nierop, "De zijdenijverheid van Amsterdam, historisch geschetst," *Tijdschrift voor Geschiedenis* 45 (1930): 18–40, 151–172; and 46 (1931): 28–55, 113–143, and H. Brugmans, *Geschiedenis van Amsterdam* (Utrecht and Antwerp: Het Spectrum, 1973) 3: 31. The bright colors associated with tulips were not as divorced from the clothing of the Dutch elite as somber but misleading paintings might suggest, as Irene Groeneweg argues in "Regenten in het zwart: vroom en deftig?" *Nederlands Kunsthistorisch Jaarboek* 46 (1995): 199–251.

42. Lorenz Seelig, "The Munich *Kunstkammer* 1565–1807," in Impey and MacGregor, *Origins of Museums*, 84–5.

43. *De Nederlandsen Bloem-Hof, of de Nauwkeurige Bloemist* (copy consulted has no title page; publication attributed by University of Amsterdam Library to Amsterdam: Harmen Machielsz and Nicolaas ten Hoorn, 1699), 7.

44. Franeau, *Iardin d'hyver* (1616), 96–104, 106, 108, 110, 114, 118, 122, 124, 125; on the Duc van Tholl, 97; on "les grans," 125. The book is filled with names of those cultivating tulips.

45. For example, Franeau, 95, 102, 104, 114, 121, 125; Rea, similarly, refers to banks of flowers as "Enamel'd" (*Flora*, "Flora. To the Ladies").

46. La Chesnée Monstereul, *Le floriste françois*, 208–213.

47. Rea, *Flora* (1665), 51.

48. Antoine Agard, *Discours et roole des medailles & autres antiquitez . . . à present rangees dans le Cabinet du Sieur Antoine Agard . . .* (Paris, 1611), 14–17, 26, 27, 31; *Catalogus oft Register vande Sonderling-Heden oft Rariteyten ende Wtgelesen Sinnelickheden . . . Die Christiaen Porrett, wijlen Apoteker, in zijn Cunstcamer vergatert had* (auction catalogue, Leiden: Jan Claesz. van Dorp, 1628); UBL, ms. BPL 2596–9, Collectie Hunger, transcription of catalogue of cabinet of Paludanus from ms. original in KB Copenhagen, ff. 190–203 (in original ms., ff. 130–140). On the collection of agates, see Schnapper, *Géant*, 191–192; on *pietra dura*, see C. W. Fock, "Pietre Dure work at the court of Prague and Florence: Some Relations" in *Prag um 1600*, 51–59; J. F. M. Sterck, "Dirck van Rijswijck. Een Amsterdamsch Goudsmid en Mozaïekwerker," *Jaarverslag Koninklijk Oudheidkundig Genootschap* (1908–09), 35–54; Seelig,

"Kunstkammer," 79. The colors of agate and marble are praised in Thomas Nicols, *A Lapidary; Or, the History of Pretious Stones* (Cambridge: Thomas Buck, 1652).

49. On the introduction of marbled paper to Europe, see Phoebe Jane Easton, *Marbling: A History and a Bibliography* (Los Angeles: Dawson's Book Shop, 1983), 33ff; Rosamond B. Loring, *Decorated Book Papers* (Cambridge, Mass.: Harvard College Library, 1942), 12–13; Richard J. Wolfe, *Marbled Paper: Its History, Techniques, and Patterns* (Philadelphia: University of Pennsylvania Press, 1990), 3–14; Graham Pollard, "Changes in the Style of Bookbinding, 1550–1830," *The Library* 5th ser. 11, no. 12 (June 1956): 79. On the role of the Netherlands, see Easton, *Marbling*, 63–66, and J. F. Heijebroek and T. C. Greven, *Sierpapier: marmer-, brocaat- en sitspapier in Nederland* (Amsterdam: De Buitenkant, 1994), 15–17; the latter authors disagree with Wolfe, who claims a more important role for Germany and France (Wolfe, *Marbled Paper*, 13). On Paludanus's early possession of marbled paper, see Heijebroek and Greven, *Sierpapier*, 14. The example of l'Estoile is from Loring, *Decorated Book Papers*, 24.

50. Easton, *Marbling*, 109, 111.

51. John Evelyn ms. in BL, "An Exact Account of the Making of Marbled Paper," quoted in Charles M. Adams, *Some Notes on the Art of Marbling Paper in the Seventeenth Century* (New York: New York Public Library, 1947), 11. Adams does not give the exact reference to the Evelyn ms.

52. UBL, Ms. Vulc. 101, Anna Maria von Heusenstain to Clusius, letter 9, Vienna, 7 May 1591. Another correspondent of Clusius's referred to a "plante . . . du papier Persien et Turquesque," but it is not clear if this was a tulip. UBL, Ms. Vulc. 101, Jacques Plateau to Clusius, letter 9, Tournay, 8 September 1592.

53. Seymour Slive, *Rembrandt and His Critics 1630–1730* (The Hague: Martinus Nijhoff, 1953), 1.

54. The chief text for the aesthetics of early seventeenth-century Dutch painting is Karel van Mander, *Den grondt der edel vry schilder-const*, the first section of his *Het Schilder-Boeck* (Haarlem: Paschier van Wesbusch, 1604). The *Grondt*, or *Groundwork*, has been edited in a separate modern version by Hessel Miedema (Utrecht: Haentjens Dekker and Gumbert, 1973), 2 vols. Miedema has also written several analyses of the chief descriptive terms in the work: Hessel Miedema, *Fracy en Aerdigh, Schoon en Moy in Karel van Manders Schilder-Boeck* (Amsterdam: Kunsthistorisch Instituut, 1984); Hessel Miedema, *Kunst, Kunstenaar en Kunstwerk bij Karel van Mander* (Alpen aan den Rijn: Canaletto, 1981), see especially 146–152, 156–159. A challenge to some of Miedema's views on Van Mander is Walter S. Melion, *Shaping the Netherlandish Canon: Karel van Mander's Schilder-Boeck*.

55. Van Mander, *Grondt*, chap. 12, stanza 21; Dodonaeus, *Cruydt-Boeck* (1618 ed.),365, "Biivoegsel." On Van Mander's use of *netticheyt*, see Melion, *Shaping the Netherlandish Canon*, 60–63. This is a concept also applied to flower painting; see Taylor, *Dutch Flower Painting*, 96, 99.

56. E.g., on shells: Pliny, *Natural History* IX.lii.

57. John Shearman, *Mannerism* (Harmondsworth: Penguin, 1967), 75, 86, 92, 100–101, 105, 139, 140–151.

58. "Door verscheydenheyt is Natuere schoone": Van Mander, *Grondt*, chap. 5, stanza 20. On this verse, see Melion, *Shaping*, 8–9, 21. A canonic example for Van Mander is the Jan van Eyck Adoration of the Lamb by the Elders in Ghent, which he valued for its clear, new-seeming colors and the variety of its composition, encompassing as many as 330 different faces. See Karel van Mander, *The Lives of the Illustrious Netherlandish and German Painters*, ed. Miedema, Vol. I, 61; f. 220 of facsimile.

59. Van Mander, *Grondt*, chap. V, stanzas 32–3. Melion comments on this passage in *Shaping*, 9.

60. Rembertus Dodonaeus, *Cruydt-Boeck* (Leiden: François van Ravelingen, 1608), 389, later annotations.

61. The subject of connoisseurship awaits full treatment, but see Zirka Zaremba Filipczak, *Picturing Art in Antwerp 1550–1700* (Princeton, N.J.: Princeton University Press, 1987); Elizabeth Honig, "The Beholder as a Work of Art: A Study in the Location of Value in Seventeenth-Century Flemish Painting," *Nederlands Kunsthistorisch Jaarboek* 46 (1995) 253–297; Elizabeth Honig, "Making Sense of Things: On the Motives of Dutch Still Life," *Res* 34 (autumn 1998): 167–183; Antoine Schnapper, *Curieux du Grand Siècle* (Paris: Flammarion, 1994). The literature on collectors is enormous, but see especially Paula Findlen, *Possessing Nature: Museums, Collecting, and Scientific Culture in Early Modern Italy* (Berkeley: University of California Press, 1994); Schnapper, *Géant*; Ellinoor Bergvelt and Renée Kistemaker, eds., *De Wereld binnen handbereik: Nederlandse kunst- en rariteitenverzamelingen 1585–1735* (ex. cat. Amsterdams Historisch Museum, 1992). Alongside connoisseurship, we can also place the setting of standards for tulips back within the context of craft guilds, whose task it generally was to maintain a level of quality in their members' product. This was true of the St. Lucasgilde, although less is said in its regulations about painting than about the other crafts included in the guild. See Hessel Miedema, "Over kwaliteitsvoorschriften in het St. Lucasgilde; over 'doodverf,'" *Oud Holland* 101, no. 3 (1987): 141–147.

62. Nicolas-Claude de Fabri de Peiresc to his brother Palamède de Valavez, Aix, 3 May 1626, in *Lettres de Peiresc*, ed. Philippe Tamizey de Larroque (Paris: Imprimerie Nationale, 1888–1898) Vol. 6: 501.

63. Parkinson, *Paradisi*, "Epistle to the Reader"; La Chesnée Monstereul, *Le floriste françois*, chap. 5, "Quelle doit estre la Tulipe, tant en ses Couleurs, Panaches, qu'en sa Forme"; Van Kampen, *Traité des Fleurs à Oignons* (1760), 60–61, "Les qualités requises pour former une belle Tulipe . . ."; [Valnay], *Connoissance et culture parfaite*, 12ff.

64. [Valnay], *Connoissance et culture parfaite*, 12–21.

65. Rea, *Flora*, "To the Reader."

66. Duthie, *Florists' Flowers and Societies*, 33, 71; Sam Segal, "Exotische bollen als statussymbolen," *Kunstschrift* 31, no. 3 (1987), 96; D. Tarver and B. Elliott, "Des Fleuristes aux Sociétés Horticoles. Histoire des Expositions Florales," in *L'Empire de Flore*, ed. Sabine van Sprang (Brussels: La Renaissance du Livre, 1996), 117–118. A possible precursor to such shows might be the use of a "theater" of tulips, arranged on racks for other collectors to examine, an invention attributed to Valnay by the *Nouvelle instruction pour la culture des fleurs* (1697), 127: "Monsieur de Valnay invented a completely lovely sort of theater, to be able to see easily and all together a whole mass of panachées mixed together according to their different colors & arranged near each other, so that, sitting in the shade & with one glance you can divert your sight with all the rarities that a large garden can produce."

67. Dodonaeus, *Cruydt-Boeck*, (1608 edition), 388.

68. Examples are numerous in the Clusius correspondence at the University of Leiden, but for several printed documents demonstrating this, see F. W. J. Hunger, *Acht Brieven van Middelburgers aan Carolus Clusius* (Middelburg: Zeeuwsch Genootschap der Wetenschappen, 1925).

69. Peiresc to Palamède de Valavez, Aix, April 10, 1626, in *Lettres de Peiresc* Vol. 6: 443; Sir Thomas Hanmer to John Evelyn, Bettisfield, 21 August 1671, quoted in introduction to Hanmer, *Garden Book*, xv; Hanmer's pocket book, quoted in introduction to *Garden Book*, xx, gives accounts of Hanmer's gifts to Lambert; BL Sloane Ms. 95, ff. 153–154, "Accounts for my Garden 1638." It should be noted that the anonymous English estate owner was clearly indulging not only in exchange but in trade of flowers. The manuscript includes entries such as "Mrs Rous hath fro[m] me 200 small Anemones to halves, and of my part m^rs Elizabeth Budding must have our half of the profitt. ffreeman oweth me 3£ upon bill wch is in my box, in lue whereof I have of him 2 tulips called Aggot Goblins wch I have set in my little square

north east, the wch I have agreed to have if I like them when I see their flowers, or els returne to him and have fro[m] him my three pounds." BL Sloane ms. 95, f. 148, "Accounts for my Garden 1638."

70. [Ralph Knevet], *Rhodron and Iris: A Pastorall as it was presented at the Florists Feast in Norwich, May 3, 1631* (London: for Michael Sparke, 1631). On florists' feasts, see Duthie, *Florists' Flowers and Societies*, 9–14; and Tarver and Elliott, "Des Fleuristes," 124. It is not clear in what fashion flowers were involved in the Norwich society's activities, although Knevet's play is full of floral references.

71. Duthie, *Florists' Flowers*, 5, 8. Duthie reports the earliest known use of the term as 1623, in a letter by Sir Henry Wotton, but Jean de Maes used "floriste" to describe amateur growers in 1599, reporting as well that "Je commençoie aussi à floriser . . . " (UBL, ms. Vulc. 101, Jean de Maes to Clusius, letter 5, Brussels, 8 April 1599).

72. Rea, *Flora* (1665), 50.

73. La Chesnée Monstereul, *Le floriste françois* (1654), 180–181. That these sentiments were not only French is perhaps indicated by the plagiarism of this passage (along with the rest of the book) by Hendrik van Oosten in his *Nieuwe Nederlandsche Bloemhof* (1700); see the English translation, Henry van Oosten, *The Dutch Gardener: Or, the Compleat Florist*, 2nd ed. (London: D. Modwinter, 1711), 160. The quotation here is my translation of La Chesnée Monstereul rather than from the English edition of Van Oosten.

74. [Valnay], *Connoissance et culture parfaite* (1688), 7–8.

75. *Ibid.*, 7.

76. La Chesnée Monstereul, *Le floriste françois*, 173–180; quotation on 173–174. Schnapper, *Géant*, 218–219, also discusses ambivalent attitudes of gardening treatises toward revealing their secrets.

77. Michel de Marolles, *Suitte de Memoires de Michel de Marolles Abbé de Ville-loin* (Paris: Antoine de Sommaville, 1657), 268.

78. My preliminary research on Haarlem suggests that some involved in tulip sales there may have been of a lower social station than in Amsterdam and thus less likely to be purchasers of art, although some were also from leading Haarlem families. Unfortunately auction records from Haarlem appear to have been lost, making this topic more difficult to investigate.

79. Casteleyn's inventory is in the Gemeentearchief, Amsterdam (GAA): GAA NA 939A/187ff., 28 August 1644. A tulip sale involving Casteleyn is recorded at GAA NA 341/155, 26 September 1611; he was obviously involved in tulip collecting from early on. On Casteleyn, see also Bergvelt and Kistemaker, eds., *De Wereld binnen Handbereik*, 316.

80. My list of Amsterdam purchasers of tulips is compiled from notarial transactions in the Gemeentearchief, Amsterdam (GAA), concerning sales or quarrels over sales. I am grateful to Michael Montias for allowing me to compare this list with the Montias/RKD Databank of buyers of art at auction in Amsterdam from 1600 to 1640. Notarial records about tulips and concerning those collectors listed include: on Bessels, GAA NA 951, 14 May 1637; on Admirael, GAA NA 917/272^{v}, 16 October 1635; GAA NA 917/310, 1 December 1635; GAA, NA 918/145^{v}, 19 May 1636; GAA NA 918/180, 12 June 1636; GAA NA 918/228, 6 July 1636; GAA NA 918/519^{v}, 8 December 1636; GAA NA 919/64, 13 February 1637; GAA NA 919/195, 13 June 1637; GAA NA 920/334, 2 December 1638; on Halmael, GAA NA 918/554^{v}, 31 December 1636; GAA NA 919/20^{v}, 12 January 1637; GAA NA 919/21, 15 January 1637; GAA NA 919/61, 10 February 1637; GAA NA 919/61, 10 February 1637; on Massa, GAA NA 1158/144–144^{v}, 27 December 1636. Adam Bessels was closely connected to the major collecting family, the Reynsts, as well as to well-known collectors such as Jacques Nicquet and Jean Renialme; Lambert Massa was connected to Renialme; his brother, Isaac, was painted by Hals three times, and his tulip purchase was from Susanna Spranger, sister of the important col-

lector Gommer Spranger and widow of Outger Cluyt. Cluyt was a son of Dirck Outgertz Cluyt, Clusius's assistant at the Leiden *hortus*, and had written a treatise on the tulip. There are many other similar examples.

81. On this question for Dutch paintings, see Marten Jan Bok, "Art-Lovers and their Paintings: Van Mander's Schilder-boeck as a Source for the History of the Art Market in the Northern Netherlands," in *Dawn of the Golden Age*, ed. Ger Luijten et al. (ex. cat. Amsterdam, Rijksmuseum, 1993), 136–166; Marten Jan Bok, *Vraag en aanbod op de Nederlandse kunstmarkt, 1580–1700* (Proefschrift, University of Utrecht, 1994).

82. Clusius to Lipsius, 22 October 1594, quoted in F. W. Hunger, *Charles de l'Escluse. Carolus Clusius. Nederlandsche Kruidkundige 1526–1609* (The Hague: Martinus Nijhoff, 1927, 1943), Vol. 2, 250. On the *rhizotomi*, see also Hunger, *Clusius* Vol. 1: 303–304, and Vol. 2: 251; Krelage, *Drie eeuwen*, 3.

83. In Dodonaeus, *Cruydt-Boeck* (1618 edition), 365. "Biivoegsel." This passage does not occur in the 1608 edition.

84. Rea, *Flora*, 71.

85. George Voorhelm, *Traité sur la Jacinte*, 3rd ed. (Haarlem: N. Beets, 1773; 1st publ. 1752), 21–22.

86. Gilbert, *The Florists Vade-Mecum* (1683), "To the Reader."

87. See especially J. Michael Montias, "Cost and Value in Seventeenth-Century Dutch Art," *Art History* 10, no. 4 (December 1987): 455–466.

88. La Chesnée Monstereul, *Le floriste françois* 1654), 194.

89. Paul Contant, "Le Iardin et Cabinet Poetique," in Jacques and Paul Contant, *Les Divers Exercices de Iacques et Paul Contant Pere et Fils Maistres Apoticaires de la Ville de Poictiers* (Poitiers: Julian Thoreau and la Veuve d'Antoine Mesnier, 1628), 55–56. Contant defends his decision to take money— the charge was that he was too "prompt & diligent\A prendre d'un chascun de l'or & de l'argent\Pour voir mon Cabinet"—by asking whether, if someone seeing his cabinet wanted to give him money for seeing it, he really had to refuse?

Inventing Exoticism

The Project of Dutch Geography and the Marketing of the World, circa 1700

BENJAMIN SCHMIDT

What do we talk about when we talk about the exotic? This depends, in part, on *when* we do the talking, though there may be no better time to listen in on the conversation than the late seventeenth and early eighteenth centuries, when the talk was relatively thick. Consider: Georg Rumphius—also known as *Plinius Indicus* for his monumental contribution to the natural history of the East Indies—spoke of the "imperfect chaos" of the exotic world that he assembled in his massive studies of Asian marine and plant life, *The Amboinese Curiosity Cabinet* and *The Amboinese Herbal*, both composed at the close of the seventeenth century. This and other remarks by Rumphius on the unwieldy business of ordering tropical *naturalia* reflect perhaps the finicky anxieties of a scholar. By contrast, Engelbert Kaempfer—the "Humboldt" of the Indies, as he came retrospectively to be known—praised the "pleasures of the exotic." Here the emphasis lay on the readers' reception of those tomes chock-full of Near and Far Eastern exotica compiled by Kaempfer in the late seventeenth century, and on the effect that these stunning descriptions, visual no less than verbal, presumably had upon their audience. And then there is the commentary of Arnoldus Montanus. Neither a Pliny nor a Humboldt was this modest schoolteacher turned geographer who delighted in the "novelty," "variety," and "strangeness" of those exotica collected in his vast, rambling books of "wonders" that explored the terrain of Asia, Africa, and America at the twilight of the seventeenth century.[1]

All of these observations derive from a particular context, and it is this context—time and place, purpose and perspective—that lends recognizable shape and valuable definition to that all-too-vaguely articulated concept "the exotic." All can be associated, that is, with the project of geography in the Dutch Republic, circa 1700: a singular burst of printing, painting, mapping, publishing, producing, and otherwise promoting

images of the non-European world undertaken chiefly in the province of Holland around the turn of the eighteenth century. Rumphius and Kaempfer both gained their knowledge of the world while serving in the Dutch East India Company; Montanus, an accomplished armchair traveler, belonged to the stable of geographers, historians, and draftsmen who worked for the Amsterdam publisher Jacob van Meurs. Finally, all of these comments, despite their identifiably Dutch provenance, circulated throughout late Baroque Europe in various editions and multiple languages, thereby conveying to a very broad audience what indeed was meant when the exotic was talked about.

To be sure, discussions focused on the idea of the exotic, both in and of the late seventeenth century, tend to be rare and still more rarely satisfying. In the first instance, few of the contemporary commentators on matters of geography chose to elaborate on their theories of the exotic; the word itself appears only infrequently in Baroque letters.[2] In the second instance—in the, by contrast, very many critical discussions of Europe's mimetic engagement with the expanding early modern world—the exotic too often gets tucked away, neatly and nonchalantly, under the broad heading of "Europe and its Other." This permits a certain laxness concerning the Other, understood simply as the object of European imperial desire. It also allows—equally problematically—considerable leeway for that grand, elastic figure of the early modern European, who habitually goes undistinguished by gender, class, culture, and so forth. It strips the exotic and its makers of context. The comments of Rumphius, Kaempfer, Montanus, and others gain their value precisely by pointing to a more cogent idea of exoticism, which pertains more particularly to late Baroque Europe—a crucial period of geographic production and European expansion that heralded the age of empire. They indicate, too, how this idea was formulated, propagated, and marketed by the Dutch, most conspicuously around 1700.[3]

The Dutch project of geography at the turn of the eighteenth century provokes a number of observations. First, the sheer quantity of materials produced in the Republic is impressive. A veritable flood of georgraphic goods—of literary works, such as travelogues, learned geographies, natural histories, and books of "wonders"; of cartographic resources, including decorated maps, multivolumed atlases, and luxurious globes; of visual artifacts, comprising tropical painting, inexpensive prints, and coveted curiosa, (the latter often sold with the cabinets that housed them)—streamed off the presses and out of the ateliers of the Netherlands, suppliers in the province of Holland manufacturing most assiduously. Second, many of the works produced in the Netherlands share a certain bric-a-brac quality that suggests a self-conscious strategy of—for lack of a better word—exoticism. Books on the extra-European world move briskly and even programmatically

among countries, customs, and creatures; the preface to one volume claims to offer only quick "morsels" of exotica, variety being the favorite spice of geographic life.[4] Paintings and prints likewise mix and match peoples and continents, embracing a lush aesthetic of eclecticism. Third, the timing of this burst of geography is significant for what it is not: coincident with any period of Dutch imperial expansion. On the contrary, the later decades of the seventeenth century witnessed a reduction of the Republic's activities abroad: the Netherlands' American colonies (in Brazil and New York) fell in the 1650s and 1660s, and the Dutch East India Company started losing relative market share at about the same time. The Republic, in other words, chose to market a world which it had a *contracting* stake in governing. Which brings up a final, crucial point: that the Dutch in fact "marketed" and sold that version of the world which their geographers so meticulously fashioned. This worked in a variety of ways. Rumphius's text very plainly promoted the valuable shells of his own cabinet of curiosities (a previous collection had been sold to Grand Duke Cosimo III of Tuscany), and Montanus—or his publisher, van Meurs—ambitiously advertised in his Asian volume the merits of another deluxe edition, *America*, by the same author-publisher team.[5] Somewhat more subtly, Kaempfer's textual descriptions of Oriental riches sold the reader on a veritable cornucopia of imports lately available in Europe, as did, in their own ways, any number of Dutch texts, which sensuously described the wondrous products of the expanding globe. Still more to the point, Dutch geography sold an *idea* of the world that appealed to readers, viewers, and consumers across Europe, and this idea marketed a world that was identifiably "exotic."

This essay investigates the development of geography in late Baroque Europe and the manner in which various modes of describing the world functioned in the decades surrounding 1700. It proposes that, in the Netherlands at this time, a category and a strategy of discourse emerged, that might best come under the rubric of "exotic." The term *exotic* has been crucial to any number of discussions of Europe's post-Columbian expansion, its establishment of commercial markets overseas, and its development of imperialist ideologies. Exoticism has served as a touchstone for analyses of colonial (and postcolonial) discourse, of European representations of the Other, and of early modern forms of geography—the evolving art and science of empire. Despite this evident centrality, however, few excavations of the term and its implications have informed the study of these topics, and certainly not the study of geography in Europe's great age of expansion. Few attempts have been made to locate the production and consumption of exotica, especially in that period bridging the Old World's initial thrusts overseas in the sixteenth and early seventeenth centuries, and

the establishment of vast European empires by the later eighteenth and nineteenth centuries.

Where do we look when we look for the exotic? To track the exotic, one need look no further than the Dutch Republic, geographers nonpareil of early modern Europe, and Dutch strategies of representing the world circa 1700. Dutch geography, prominent enough in the early years of Renaissance exploration, expanded dramatically in the final decades of the seventeenth century. In an astonishing assortment of media, the Dutch described, delineated, reproduced, and otherwise propagated images of the world beyond Europe. This applies not only in terms of the great quantity of works issuing from the Republic. It characterizes also the phenomenal variety and dazzling quality of texts, images, and objects pertaining to geography (the products) and the extraordinary extent of their dispersal (their consumption). The Republic, quite simply, dominated the field. By consequence, it framed the way most Europeans viewed the globe at the turn of the eighteenth century.

Dutch geography came in various shapes and forms, genres and media. There were, to begin with, "traditional" geographies (sometimes published under the name "cosmographies"), which, in the humanist mode, sought to detail the lay of the world. These were printed texts, which became, in many instances, authoritative textbooks: Philip Cluverius's *Introductionis in universam geographiam*, which appeared in a staggering sixty-seven editions by 1725; Bernard Varenius's widely cited *Geographia generalis*; and the vast, omnibus works of Georg Hornius—"social" studies on the empires of the world, the origins of the races, the nature of world polities, and the like—that numbered forty editions in the final third of the century.[6] Next came the regional studies—fabulous, often folio works, sometimes called "atlases" and generally brimming with engraved prints, foldout maps, and panoramic views—that filled a market for "local" geographies of the non-European world: Schouten on Siam (nearly twenty editions), Nieuhof on Brazil (yet another Jacob van Meurs title), Baldaeus on Malabar (reprinted in Churchill's acclaimed *Travels*) (fig. 14.1).[7] The magnificent natural histories done in the Republic might also strive to be global, yet this genre tended to encourage studies that were site-specific: Maria Sibylla Merian's glorious *Metamorphosis insectorum Surinamensium*, Hendrik van Reede tot Drakestein's twelve-volume *Hortus Malabaricus*, and Rumphius's *Amboinsche rariteitkamer*, all of which appeared in the *decennium mirabilius* of exotic natural history, 1695–1705.[8] The Dutch also produced a notably large share of travel narratives: well over fifty editions of Willem Bontekoe's adventures in South Asia; multiple versions of Ogier Busbecq's life among the Turks; thick accounts of Cornelis de Bruyn's journeys to the Levant and Muscovy. And they were behind some of the most important travel anthologies:

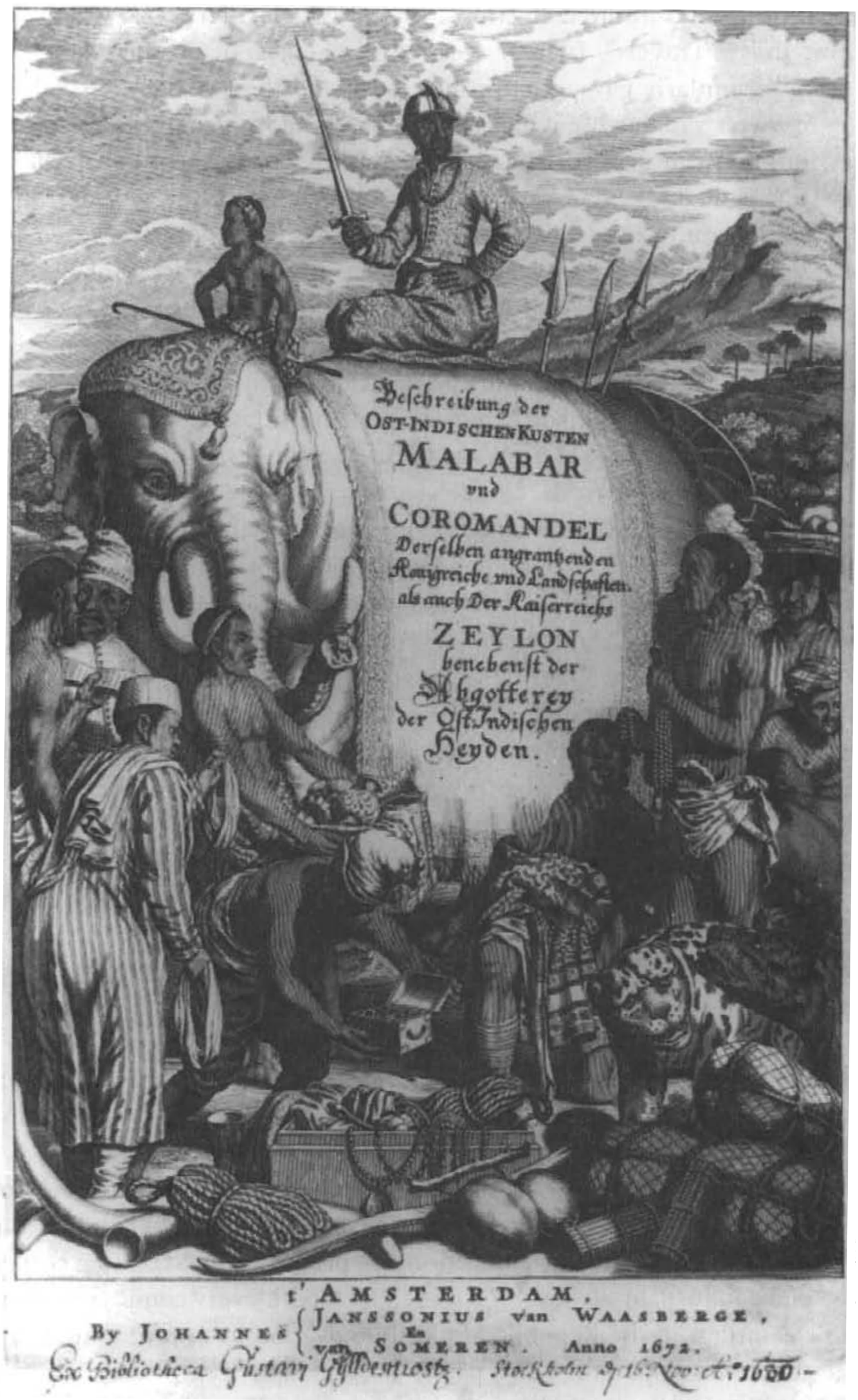

Figure 14.1 Frontispiece from Philippus Baldaeus, *Wahrhaftige ausführliche beschreibung der berühmten ostindischen kusten Malabar und Coromandel, als auch der insel Zeylon* (Amsterdam, 1672). Courtesy of the Rosenfeld University. University of California, Los Angeles.

sprawling, multivolume collections, including Hartgers' "Voyages" and Commelin's "Travels" (which formed the basis of Renneville's and Churchill's similarly gargantuan collections); and the twenty-eight volume series of Pieter van der Aa, which served as a standard geographic reference work for half a century.[9] A final category that comes under the rubric of "literary" text is the Dutch books of wonders and "things-of-the-world." These described, in some cases, a single set of attributes or customs surveyed in a global setting: Balthasar Bekker on the universality of witchcraft or Bernard Picard on world religions, for example. In other cases, they jumbled together, *Kunstkammer*-like, the miscellaneous mores and disparate marvels of the world; arranged these quirky attractions with purposeful disregard for place; and finally framed them with enticing titles, such as "The Great Cabinet of Curiosities," "The Warehouse of Wonders," or, most bluntly, "The Wonder-Filled World."[10]

Also from the Netherlands came a stupendous outpouring of cartographic texts, which placed the Republic in the enviable position of mapmaker to Europe. From the workshops of Blaeu, Janssonius, and de Wit came the preeminent "grand" atlases of the later seventeenth century. Under the signs of Colom, Donker, and van Keulen one could obtain the most sought-after "water worlds," or sea atlases, on the market. Alongside these sumptuous, often folio works were simpler "minor" atlases and plain sheet maps for the cost-conscious. Available for the truly profligate, though, were the high-end wall maps, which decorated the finest homes of Europe. Elaborately decorated and often hand-colored, these could cost more even than an atlas; they also came in made-to-order "floor models": mosaics of the world mapped onto a patron's floor. Deluxe Dutch globes spun in the best studies and princely corridors of Europe; miniature "pocket" globes, meanwhile, could be conveniently carried across the continent. And, just as Dutch printers and engravers produced city views, topical news maps, and topographical panoramas (some up to 2 meters in length), so did Dutch draftsmen and painters, often working from the same original sketches, furnish more durable scenes of the identical exotic terrains done in watercolor and oil.[11]

From Dutch painters, too, came diverse visual versions of the non-European world. Tropical landscapes—a genre wholly invented by the Dutch in the second half of the seventeenth century—presented the far-flung corners of the globe in lush, opulent color (fig. 14.2). Here the very competitive market for paintings in the Republic induced innovation by encouraging artists to select, and then specialize in, a particular region or style. Frans Post, perhaps most famously, painted verdant variations of Brazilian life—though other regions had their masters. Dirk Valkenburg cornered the market for Suriname scenes; Andries Beeckman did the same for the East Indies; and Gerard van Edema applied his brush to that growing urban jungle known

Figure 14.2 Frans Post, *View of Olinda*, 1662 (canvas, 107.5 x 172.5 cm). Courtesy of the Rijksmuseum, Amsterdam.

as Manhattan, which he rendered in vaguely pastoral, *capriccio* views. Other genres also developed. Painters of the Republic reproduced on canvas the products and peoples of the world—as in Albert Eckhout's studies of the non-European inhabitants of Brazil—and the flora and fauna of the tropics. Many of these images were subsequently recycled in still lifes and other exotic compositions—Jacob van Campen's *Triumph, with Treasures of the Indies* combines elements of still-life painting with human figures bearing the rich harvest from overseas—or in delftware, tapestries, and other decorative arts (fig. 14.3).[12]

The actual objects depicted on the canvas had their market as well, which the Dutch skillfully supplied. The Republic, that is, did a brisk business provisioning the *Kunst-* and *Wunderkammern* of Europe. Rumphius's shells went to the ducal cabinet of Cosimo, who beat out Peter the Great of Russia, one of the many (and most extravagant) shoppers to visit the Netherlands in search of collectibles. Shells were certainly the best preserved exotica available and therefore the most popular items for sale. Yet a wide variety of *naturalia*, *artificialia*, and hybrid items bridging the two—finely painted animal horns, artfully crafted fossils, ingeniously worked coral—could be had for a price from Dutch collectors, who readily dispensed with their holdings in precisely these years. Tourists in the Republic also made sure to visit the splendid botanical and zoological gardens in Leiden, Amsterdam, and Rotterdam, which were well stocked with imports from the East and

Figure 14.3 Polychrome tile panel, Delft (workshop unknown), ca. 1700 (170 x 79 cm). Courtesy of the Rijksmuseum, Amsterdam.

West Indies; and they called on the renowned physicians of Holland, who possessed among the finest collections of simples and specimens in Europe. Finally, the Dutch plied a trade in the actual cabinets that contained these collectibles. Commonly constructed out of tropical woods or other imported materials, and elaborately decorated with scenes meant to evoke the distant lands from which the treasures within had derived, these cabinets offered consumers yet one more opportunity to imagine the shape of the exotic world—or at least the Dutch version thereof.[13]

The products of Dutch geography, which spanned so many genres, forms, and styles, also spanned multiple communities of readers, collectors, and consumers, reaching markets far and wide. This is easiest to see in the category of printed sources, which circulated exceptionally broadly at this time. Texts on the extra-European world—a seaman's narrative, for example—might appear originally in inexpensive octavo or duodecimo, with crude woodblock prints and the vaguest of maps. Yet these images might be redone by the same or another publisher with expertly engraved plates, detailed maps, and text printed in folio. Or the reverse: a text first offered in massive, luxury editions might be pirated by a publisher working for the lower-end market, who would offer an abridged edition at a favorable price. Plates were commonly recycled as well, with or without an accompanying text. Romeyn de Hooghe's *Les Indes Orientales et Occidentales* (1710), a tour de force of engraved exotica executed in a striking, oblong format, furnished images for any number of other texts that had little or nothing to do with de Hooghe's original commission.[14] More basically, Dutch geographic texts were recycled in translation. What is particularly impressive about this process, certainly not uncommon in early modern publishing, was the degree of control exercised by Dutch publishers over their product. Translations usually derived *from the original publisher* in the Republic, whose editions would then compete with, and generally prevail over, translations undertaken by foreign publishers. German, French, and Latin works of geography commonly came from Holland, where printers employed a core of translators. The Royal Geographer of Restoration England, John Ogilby, may have departed from this pattern somewhat by hiring his own translator, yet he commonly ordered his prints from Amsterdam and produced a final product that was (Ogilby's boastful claims of authorship notwithstanding) undeniably Dutch.[15]

In the case of other sources of Dutch geography, patterns of dissemination are perhaps less plain—yet the fact of their dispersal throughout Europe is abundantly clear. Brazilian landscapes by Frans Post shipped to Versailles, part of a spectacular trove of Dutch Americana purchased by Louis XIV. Tropical still lifes by Albert Eckhout went to Frederick III of Denmark, gaining a prime position in the royal collection in Copenhagen. And cartographic watercolors from the venerable Vingboons atelier reached Rome by order of Christina of Sweden, who abdicated her throne in Stockholm en route to becoming a leading patron of Baroque arts and letters. Dutch images, like Dutch texts, spread across the continent. They provided, in short, rich and plentiful models for those who would contemplate the exotic world.[16]

The sum of these sources and their dissemination constitutes what might be called a geographic moment, which can be traced to the final decades of the seventeenth century and early years of the eighteenth. This poses a sim-

ple pair of related questions: Why then—around 1700? And why there—the Dutch Republic?[17] That the Netherlands triumphantly concluded an epic Eighty Years' War against Spain in 1648, and that their success in foreign policy had boded well for domestic affairs, cultural no less than economic—the Dutch Golden Age—may explain in part the vibrancy of Dutch geography, which was, in essence, a cultural export with economic dimensions. Yet 1648 denotes not so much the dawn as the dusk—or perhaps, pre-dusk dimming—of that Golden Age, which was, by most measures, in a state of decline by the wonder years of Dutch geography. What *had* changed by the end of the war was the harshly polemical representations of Habsburg "tyranny," as the Dutch chose to characterize Spanish government both at home and abroad. By the second half of the century, with no need to demonize the enemy, descriptions of Spain and its empire had become more mild; Dutch geography lost its habitual Hispanophobic edge.[18] This shift accounts for questions of quality rather than quantity, however. It fails to explain the Dutch dedication to worlds overseas in the first place, and the assiduous concern of the new Republic with matters imperial.

The conclusion of the Netherlands' struggle against Spain did free up ships and soldiers, which might suggest an expansion of colonial efforts—and a parallel extension of colonial discourse in the form of geography. Yet the very opposite would seem to be the case, at least as far as Dutch overseas expansion is concerned. Dutch settlements in America collapsed, in fact, in the years immediately following the Treaty of Münster (1648)—New Holland (Brazil) succumbed to a joint Spanish-Portuguese armada in 1654, while New Netherland fell to the duke of York only a decade later—and the Dutch West India Company declared bankruptcy by 1664. In Asia, though there were no such dramatic setbacks, the Republic experienced a number of reversals and contractions and a loss of relative market share to its European competitors. By the later seventeenth century especially, the Dutch East India Company had given ground to the English and French; and if the VOC (as the Company was called) still turned a profit, it did so increasingly as middlemen in inter-Asian trade rather than masters of pan-Asian domains. Rather than land-based, imperial ambitions, the Republic cultivated more profit-minded, commercial strategies. In both the East and West Indies, the Dutch peddled the products—the stuff—of the world. And increasingly, they also plied a trade in the *image* of the world, which took the form of geography.

The image of the world marketed by the Dutch came in many forms. Yet this image, in virtually all of its permutations, shared certain qualities and followed discernible patterns that may be said to characterize the Dutch brand of geography flourishing circa 1700. These qualities and patterns,

moreover, functioned to render this image—the Dutch production of the world—agreeable and therefore salable to the broad, Europe-wide audience for Dutch geography. Taken together, they constitute an identifiable and effective strategy of representation, which might be termed "exoticism."

The world according to Dutch geography was a rich, jumbled hodgepodge of peoples and places, the creatures of one land and customs of another slipping easily across borders and even continents. It was a resolutely disorderly world, not infrequently described as "strange," somewhat paradoxically as "novel," or more prosaically as "marvelous." It burst with social, cultural, and natural bric-a-brac, arranged with seemingly careless disregard for order or provenance. Dutch geography was eclectic and notably catholic: all manner of scenes and snippets of exotica, described by all manner of European observer, were made welcome. Yet there was a method to this madness, or at least a pattern to the chaotic clutter of Dutch geography.

Dutch geography emphasized, firstly, variety. The mix-and-match quality of texts and images was often by design, and difference was accentuated—not so much to distinguish the cultures and landscapes of the world as to conflate them. Distinctions, like borders, were studiously erased. Here a strategic shift becomes apparent, when works of geography from the later seventeenth century are compared with those dating from just a few decades earlier. Johan Nieuhof's masterly description of Brazil, penned originally in the middle of the century—at the height, namely, of the Dutch West India Company's (WIC) struggle against Portugal—appeared finally in 1682, combined with the author's reports on the *East* as well as West Indies. In place of the original, carefully focused narrative of the Republic's tenure, and then decline, in South America, the reader now contends with a swirl of exotic settings, ranging "from China to Peru." Orient and Occident comfortably commingle, at times with haphazard abandon. Brazilian flora segue to Chinese fauna, while Jewish merchants of Recife bump up against tobacco-addled natives of Malaysia.[19] In much the same spirit, an edition of Willem Piso's *Historiae naturalis Brasiliae*—first introduced in 1648 by a director of the WIC, who unabashedly endorsed the Netherlands' empire in Brazil—was reissued after the fall of New Holland, carrying in this later version a preface in praise of wonders and a newly appended, yet otherwise incongruous, study of Asian *naturalia*. A fresh frontispiece engraved for this second edition casually blends a heraldic Brazilian figure with a vaguely Persian one—neither, to be sure, having much to do with the natural histories within.[20] This sort of inspired eclecticism is particularly embraced on the frontispieces of (printed) Dutch geographies. The magisterial *Ceremonies et coutumes religieuses des tous les peuples du monde*, published initially in Amsterdam in 1723, opens with a fabulous melting pot of intercontinental reli-

gion; Simon de Vries's *Curieuse aenmerckingen der bysonderste Oost- en West Indische verwonderens-waerdige dingen* (Curious observations of the most exceptional East and West Indian wonders, 1682) entices the reader with a baroque blend of global goods; and Joan Blaeu's monumental *Atlas maior* (1662 and following) announces itself with an allegory of all the world's parts, offering an iconographic image and a cartographic style that would become standard for the next half century.[21]

Dutch geography collapsed distinctions, and, while efforts were certainly made to compare and contrast, this was done in a peculiar "analogistic" style that suggests, once again, a shift in discursive method. Whereas Hernán Cortés, in the early sixteenth century, found the towers of Mexico evocative of Seville and Granada—crucial loci, it should be stressed, of the Spanish *Reconquista*—Arnoldus Montanus by the 1670s associated Mexican temples with those of China and Japan. Montanus, that is, matched exotic with exotic; Cortés, meanwhile, compared newly won Spanish domains with the soon-to-be colonized province of New Spain.[22] Dutch geography, more generally, celebrated the vastness of the world and conflated global space—which offers yet another point of contrast, in this case with contempory geographic agendas. Thus, where an Athanasius Kircher or Joseph-François Lafitau infused the study of geography with a pronounced historical dimension—comparing Native Americans or Ch'ing Chinese with the Ancients—an Arnoldus Montanus or Olfert Dapper pursued the "savage" (or "civilized") American by looking to examples in Asia and Africa. Dutch cross-references tended to be spatial, not temporal; Dutch geography expanded the globe rather than excavated the past. Dapper (who, like Montanus, collaborated frequently with the indefatigable Jacob van Meurs) exemplifies this trend in his very impressive and extensive oeuvre: two tomes on Africa, an immense volume dedicated to China, three lavish works on the Near East and South Asia, two more sprawling accounts of the Mediterranean. All were done in the space of two decades, and it is no wonder that engravings of "races" tend naturally to collapse the different continents; that the term "Indian" is applied to Chinese and American indigenes alike; that the "biggest," "richest," and "most fabulous" marvels of the world seem to resurface in multiple exotic locales. How could there not be a fair amount of geographic bleeding from text to text, region to region, race to race—in some instances creating a stunning kaleidoscope of global color—for this author of thousands of wonder-filled pages, whose stream of publications would finally crest with the aptly titled, two-volume anthology *Dapperus exoticus curiosus*?[23]

The world fashioned by Dapper and his colleagues was unusually fluid and supple. It was a decontextualized space, with no obvious center and with minimal orientation. Cornelis de Bruyn, a superbly capable draftsman from The Hague, took his sketch pad on a tour of the globe and recorded, in a single

whirlwind volume, his impressions of Russia, Persia, Sri Lanka, and the East Indies. In another, equally remarkable volume of travels, de Bruyn transported his readers to the Levant and North Africa, with stops en route in Habsburg Austria and Italy. In both works, de Bruyn insisted on taking the most indirect narrative routes imaginable, pausing occasionally to tidy things up with chapters devoted to "Odd Matters": miscellany that merit otherwise haphazard attention.[24] Arnoldus Montanus, who hardly ever left the bosom of Holland, almost made a virtue of discursiveness—which provoked fierce attack from competing (non-Dutch) geographers.[25] Montanus had no reason to worry: his very popular *Atlas Japannensis* spun the reader from inquests into native flora to reflections on Buddhist dogma, from volcanic topography to Tokugawa history, from snippets on local reptiles to the wisdom of Shinto priests. It went through nine editions in French, German, English, and Dutch, exasperating Montanus's critics—though not his faithful readers—for more than half a century. (His *America*, if slightly less digressive in form, turned out to be slightly less successful as well: a mere three editions in three languages.) These and other examples of Dutch geography cultivated a meandering style and flaunted a purposeful indeterminacy. They eschewed—once again, relative to other traditions of geography—the sort of "national" perspective that had characterized earlier works by Hakluyt, Purchas, Ramusio, and Herrera. Dutch geography lacked a sharp focus and avoided a straightforward narrative. Many of the texts it produced were (and still are) all but unreadable.[26]

Or rather, many of the texts resisted the sort of linear reading to which their critics may have subjected them—though this may be the point. For if Dutch geography discouraged easy, systematic study (this apropos of printed, literary materials), it did encourage a more flexible, almost casual style of perusal. Volumes of Dutch geography are, fundamentally, immense and cumbersome objects. This pertains both to the length of the text—many of the works produced in this period run nearly, and sometimes over, a thousand pages—and to its format, which often was delivered in an imposing folio. They do have outstanding indices, most include helpful tables of contents, and they often have summary chapter headings. If readers could only uncomfortably clasp one of the enormous products of Dutch geography, then, they could easily browse the volume and readily taste the diverse "morsels" of exotica (as one editor referred to them) offered within. Prefatory materials sometimes advocated just such a cursory manner of scanning the text. One author sheepishly confessed at the outset of his 938-page survey of world religions that his book was wholly wanting of an organizing principle. Another cheerfully noted his role in gathering, and then scattering, data for the soon-to-be overwhelmed reader, pointing out that no single person could possibly master the harvest of exotica that he had reaped: "*Non omnia possumus omnes*."[27] Many of these editions sought to make mat-

ters easier on the reader by their generous inclusion of figures, engraved plates, and pull-out maps, adding a visual component to the text that further invited skimming. Indeed, the extensive illustration programs of printed Dutch geographies also lent a fluidity, and even interchangeability, to these sources. Plates produced for one volume typically reappeared in others, and a reader could hardly be faulted for eliciting only the broadest and most basic themes from the resulting, perhaps recycled product. Dutch geography in its printed form—immense, attractive, elegantly illustrated, and programmatically superficial—may represent a first generation of coffeetable books at the dawn of the age of coffee.[28]

Specimens of Dutch geography, whether *pronk* or not—the Dutch word, not easily translated, well conveys the quality of sumptuousness and ostentation inherent in so many of these objects—often drew attention to themselves. Books, images, and artifacts all had an importance in and of themselves, which came at the expense of their subject—the swirling mélange of places to which they were ostensibly dedicated—and their nominal authors. This, in turn, had the effect of effacing authorship, if not authority. Which is not to suggest that the original voyagers, draftsmen, and naturalists who produced Dutch geographies went unnamed; some did, if many did not. Yet even when original authors were cited, the text had a way of taking attention away from specific places and persons—Johan Nieuhof in the East Indies, say—and directing it on the work itself. Again, a useful contrast can be drawn with other samples of geographic literature. Dutch texts of this period rarely have recourse to what Anthony Pagden has called the "autoptic imagination": the device, so prevalent in early modern travel narratives, of privileging eyewitness evidence and first-person presence when describing new worlds.[29] Dutch texts, on the contrary, commonly obscure the author, following his (and it nearly always is a *he*) perfunctory opening remarks. This made the Indies the subject, rather than Nieuhof's personal experience there. More generally, it allowed products of Dutch geography to be more widely accessible—less rooted in a particular Dutch experience. Broad dissemination came easily to these products, if piracy, likewise, naturally followed. Thus could John Ogilby brashly claim authorship of Montanus's and Dapper's major works, which he repackaged and incorporated into his multivolume "great atlases" of the exotic world.[30]

Which brings up one more vital quality of Dutch geography: its semblance of neutrality. Dutch descriptions of the world endeavored to be disinterested. They dispensed as far as feasible with the built-in biases of geography, and they disguised where they could the Dutchness of their product—yet another strategy meant to foster Europe-wide consumption. Painters, accordingly, hid the fact of the Republic's prior presence in their renderings of exotic landscapes—as Frans Post did in his Brazilian scenes,

which as often as not highlighted the *Portuguese* inhabitants of this formerly Dutch domain; and as Gerard van Edema did in his views of New York, which he undertook almost exclusively for an English clientele. Texts, too, went out of their way to be evenhanded. When Philippus Baldaeus composed a geography of Malabar (India), he opened his account with a strikingly inclusive survey of traffic to the region by "the Dutch, English, Moors, and Portuguese." Evert Ysbrand Ides frankly acknowledged the political purposes of his voyage from Moscow to Beijing (he traveled at the behest of the Amsterdam regent, Nicolaes Witsen, in an embassy of the czar), yet emphasized his chief "Obligation . . . to impart to the curious World what I saw and observ'd in my Journey"—fabulous exotica—rather than to relate the political and commercial horse-trading done for his patrons.[31] Dutch geography chose not to narrate the story of the Republic's rise overseas, and it conspicuously lacked an aggressively "national" focus. The late seventeenth-century Republic, it merits repeating, produced no Hakluyt or Herrera to sing its imperial glories. Indeed, Dutch geography in this period avoided any taint of politics or hint of polemic—at least as far as European rivalries were concerned. Studies of Japan gave reasonably sympathetic accounts of the persecution of the Catholics—when penned by Calvinist authors, no less—and of the expulsion of the Portuguese. Maps of the Americas erred on the side of neutrality when it came to charting colonial control. Even old rivals could be reconciled in the world of Dutch geography. A remarkable vignette in one widely translated travelogue describes how a Hollander and a "fine" Castilian met on a Moluccan island, where the two discussed the benefits of "amity" among Christians. They agreed that their nations, ancient and fierce rivals, might now fruitfully cooperate in the conversion of the heathen. This friendly tête-à-tête pointedly gives way to a jaunty discourse on birds of paradise and other exotica of the bountiful, and presumably mutually profitable, tropics.[32]

Such soft "internationalism," wholly foreign to earlier Dutch descriptions of Habsburg "tyranny" in the Indies, was not uncommon to the products of Dutch geography manufactured around 1700. By this time, memories of the epic struggle against Spain (concluded in 1648), of the highly charged Anglo-Dutch Wars (waged chiefly in the 1650s and 1660s), and of the French invasion of the Netherlands (1672) were quickly fading—or at least mellowing enough to permit a depiction of the world that appeared, to most European consumers, mostly inoffensive. Works of Dutch geography, despite their abundance of "color," despite their tendency toward strangeness, and despite their embracement of difference, often had a neutral, almost generic quality to them. The potpourri of countries and customs, of peoples and products, could come across finally as bland. Diffuse, digressive, often disorienting, sometimes recycled, purposely decontextualized: Dutch geography

ended up being specific to none and thus palatable to all. The exotic world designed by the Dutch was a brand, ultimately, of very wide appeal.

Geography, whether local or global, has a double context: the place and time of production, and the place and time of consumption. Comprehending both of these contexts establishes a firmer foundation for understanding the nature of the imagined world (*geo*) and its description (*graphia*), a step, in turn, toward understanding that common substance of geography, the exotic. The Dutch Republic emerged as the leading geographer of Europe around the turn of the eighteenth century, a critical moment in the construction—imaginative as well as real—of the modern world. At the advent of the age of empire, as England and France especially intensified their expansion east and west, the Netherlands assumed the role of chief purveyor of words, images, and ideas concerning the globe. Europeans devoured the products of geography at the very moment that they began to gobble up the colonial world. The Republic, meanwhile, set to the task of manufacturing *representations* of that world. It is not that the Netherlands had no part in the expansion of overseas commerce at this time: the Dutch continued to trade in Asia (if less so in America and Africa) and certainly trafficked in imported non-European goods. Yet, by the late seventeenth and early eighteenth century, there was a marked shift away from expansionist, imperial, colonial projects—and an upsurge in the production of geography. The Republic, in other words, became less and less engaged in land-based empire, while becoming more and more involved in an empire of images: geography. Increasingly, the Dutch marketed, rather than colonized, the world.

The Dutch plied their trade in geography in multiple profitable ways. They sold, most basically, the actual wares of geography: books, maps, paintings, prints, and artifacts, which retailed at a considerable profit. Folio volumes—to cite but one example—fetched spectacular prices in the late seventeenth century, especially when sold in large orders. Six hundred readers signed on for François Valentijn's *Oud en Nieuw Oost-Indiën* at a cost of 38 guilders per five-volume set, netting the publisher a phenomenal gross of 20,000 guilders—this, when the average VOC sailor earned 120 guilders per annum. Servants of the Company, nevertheless, might supplement their wages by dealing in exotica on the side—such as the birds of paradise abundant in the Moluccas, or the lucrative shell collections of Rumphius, which the author sold, replenished, then sold again. Geography was good business.[33] Yet, more than the mere objects of geography, the Dutch sold the very *things* of the world in mimetic form—representations of actual, exotic merchandise—in their breathless descriptions and enticing promotions of those foreign products lately available in Europe. Dapper lavished loving attention on the Damascus bazaar, where the "choicest and dearest" things—silk garments, gold and silver jewels, sables, pearls, "and also slaves of both sexes"—could be had. One van Meurs-produced print

Figure 14.4 "Diverse Sorts of Bonnets / Verscheiden slagen van Bonnetten." Engraving from John Ogilby, *Atlas Chinensis* (London, 1671), based on Olfert Dapper, *Gedenckwaerdig bedryf der Nederlansche Oost-Indische Maetschappye, op de kuste en in het keizerrijk van Taising of Sina* (Amsterdam, 1670). Courtesy of the William Andrews Clark Memorial Library, University of California, Los Angeles.

arranged a selection of Oriental goods catalog-style, the adjacent "copy" (as it were) supplying the reader with nearly every commercial detail save the shop address where the commodities could be purchased (fig. 14.4). Other prints advertised other costly imports with monumental reproductions: the "Clove Tree" in Nieuhof's *Indien*, depicted literally on a marble pedestal; or Kaempfer's homage to the tea plant and its elaborate preparation, engraved as an impressive pull-out feature to his study of Japan. Frontispieces (and paintings) exhibit almost without fail the most stupendous riches of the globe—Japanese lacquerwood, Brazilian sugarcane, African ivory, Indian incense, Chinese porcelain, Persian carpets—which virtually spill out of the picture frame and onto the viewer's lap (see previous fig. 14.1).[34]

Most of all, though, the Dutch sold an *idea* of the globe, and that idea made the non-European world seem immensely, alluringly, and ineluctably desirable. For the world formulated by Dutch geography was not simply full of commodities, open to trade and potential profit. It was, more merely full of wonder, engagingly disheveled and charmingly chaotic. It was also cannily decentered and politically decontextualized, which transformed it, as a result, into a realm cleansed of commercial rivalries and refreshingly clear of colonial polemics. Instead of a hotly contested space of exploding imperial antagonisms, the non-European world created by the Dutch abounded with curiosities, diversions, and delight. It was, in the end, not so much the products of the world as the world as product that captivated the armchair traveler. The world of Dutch geography beckoned the consumer with what one magnificent tome of Asiana succinctly pronounced "the pleasures of the exotic": *Amoenitates exoticae*.

All of this was by design. At the turn of the eighteenth century, as European expansion and imperial jostling began significantly to intensify, the architects of Dutch geography constructed a world—pursued a marketing strategy, as it were—of extraordinarily wide appeal. The world fashioned by the Dutch was not only enticing; it was broadly inviting and readily agreeable to the avid consumers of late Baroque and early Enlightenment geography. The Dutch represented the world circa 1700 as a supremely seductive and wonderfully accessible space. To Europeans, at least, this world appeared enchantingly, amenably, and reassuringly exotic.

Notes

1. Georgius Everhardus Rumphius, *D'Amboinsche rariteitkamer* (Amsterdam: François Halma, 1705); idem, *Het Amboinsche Kruid-boek* (Amsterdam: François Changuion, 1741), from which the quotation derives (n.p.); Engelbert Kaempfer, *Amoenitatum exoticarum politico-physico-medicarum fasciculi V, quibus continentur variae relationes, observationes & descriptiones rerum Persicarum & Ulterioris Asiae* (Lemgo: H. W. Meyer, 1712); and Arnoldus

Montanus, *Gedenkwaerdige gesantschappen der Oost-Indische Maetschappy in 't Vereenigde Nederland, aen de Kaisaren van Japan* (Amsterdam: Jacob van Meurs, 1669), for which see the English edition, *Atlas Japannensis* (London: John Ogilby, 1670), 488. For Montanus's predilection for wonders, see also idem, *De wonderen van 't Oosten ofte de beschrijving en oorlogsdaden van Oud en Nieuw Oost-Indien* (Amsterdam: Cornelis Jansz, 1655); and idem, *Oud en Nieuw Oost-Indien* (Amsterdam: Cornelis Jans[z] Zwol, [1680]).

2. The term first comes into usage in the literature of natural history, a notably precocious example being Carolus Clusius's [Charles de L'Ecluse] *Exoticorum libri decem* (Leiden: Plantin Office [Raphelengius], 1605). And when "exotic" does appear in print, it tends to be in Latin: rare is an instance of the word in Dutch, German, or English vernacular letters.

3. The literature on early modern "exoticism" per se is virtually nonexistent—though the subject is skirted in the expanding field of "wonder" studies. Of the many recent titles on the latter topic, see Stephen J. Greenblatt, *Marvelous Possessions: The Wonder of the New World* (Chicago: University of Chicago Press, 1991); Lorraine Daston and Katharine Park, *Wonders and the Order of Nature, 1150–1750* (New York: Zone Books, 1998); and Mary Baine Campbell, *Wonder and Science: Imagining Worlds in Early Modern Europe* (Ithaca, N.Y.: Cornell University Press, 2000). Two very useful and provocative studies, focused on texts somewhat earlier and slightly later, respectively, than those cited in this essay, are Mary Baine Campbell, *The Witness and the Other World: Exotic European Travel Writing, 400–1600* (Ithaca, N.Y.: Cornell University Press, 1988), and Peter Mason, *Infelicities: Representations of the Exotic* (Baltimore: Johns Hopkins University Press, 1998). For more generalized overviews, see Bernard Smith, *Imagining the Pacific: In the Wake of the Cook Voyages* (New Haven, Conn.: Yale University Press, 1992), 1–39 ("Art in the Service of Science and Travel"); and G. S. Rousseau and Roy Porter, eds. *Exoticism in the Enlightenment* (Manchester: Manchester University Press, 1990), especially the editors' introduction, 1–22.

4. P[etrus] de Lange, *Wonderen des werelds* (Amsterdam: Marcus Willemsz Doornick, 1671), sig. A2v. Cf. also the translator's preface to Thévenot's *Travels*: "He [Thévenot] therein gives you a succinct account of all that is curious in every place, and a character of the several people. In short, he says enough to give one a reasonable information of those countreys, and not too much, to cloy the reader with the repetition of what hath seen before" (Jean de Thévenot, *The Travels of Monsieur de Thevenot into the Levant*, trans. Archibald Lovell [London: Henry Clark, 1687], n.p.).

5. Arnoldus Montanus, *De nieuwe en onbekende weereld: of Beschryving van America en 't Zuid-land* (Amsterdam: Jacob van Meurs, 1671). On Rumphius and his shells, see the superb introduction by E. M. Beekman to Georgius Everhardus Rumphius, *The Ambonese Curiosity Cabinet*, trans. and ed. E. M. Beekman (New Haven, Conn.: Yale University Press, 1999).

6. The classic bibliographies of Dutch geography—P. A. Tiele, *Nederlandsche bibliographie van land- en volkenkunde* (Amsterdam: Frederik Muller, 1884), and idem, *Mémoire bibliographique sur les journaux des navigateurs Néerlandais réimprimés dans les collections de De Bry et de Hulsius, et dan les collections hollandais du XVIIe siècle* (Amsterdam: Frederick Muller, 1867)—tend to adopt a less generous view of the range of "geography" than do I in this essay, and they offer, therefore, only moderate guidance. For works with any relevance to the Dutch experience in Asia, however, see John Landwehr, *VOC: A Bibliography of Publications Relating to the Dutch East India Company, 1602–1800* (Utrecht: HES, 1991); and, for books that make mention of the Americas—which applies to the geographies of Cluverius, Varenius, and Hornius—see John Alden and Dennis Landis, eds., *European Americana: A Chronological Guide to Works Printed in Europe Relating to the Americas, 1493–1750*, 6 vols. (New York: Readex Books, 1980–1997). More broadly useful is John Landwehr, *Studies in Dutch Books with Coloured Plates Published 1662–1875: Natural History, Topography and Travel Costumes and Uniforms* (The Hague: Junk, 1976).

7. Joost Schouten, *Notitie van de situatie, regeeringe, macht, religie, costuymen, traffijcquen, ende andere remercquable saecken, des Coninghrijcks Siam* (The Hague: Aert Meuris, 1638), which appeared in English, German, French, Latin, and Swedish, mostly in the second half of the century; Johan Nieuhof, *Gedenkweerdige Brasiliaense zee- en lantreize* (Amsterdam: Widow of Jacob van Meurs, 1682); Philippus Baldaeus, *Naauwkeurige beschryvinge van Malabar en Choromandel, der zelver aan grenzende ryken, en het machtige eyland Ceylon* (Amsterdam: Johannes Janssonius van Waasberge and Johannes van Someren, 1672); and cf. Awnsham and John Churchill, eds., *A collection of voyages and travels*, 4 vols. (London: Awnsham and John Churchill, 1704).

8. On all three — and on the *decennium mirabilius* more generally — see David Freedberg, "Science, Commerce, and Art: Neglected Topics at the Junction of History and Art History," in *Art in History/History in Art: Studies in Seventeenth-Century Dutch Culture*, ed. David Freedberg and Jan de Vries (Santa Monica, Calif.: Getty Center for the History of Art and the Humanities, 1991), 376–428. The *Hortus Malabaricus* first appeared in 1678, with complete editions following in 1683 and 1703.

9. Garrelt Verhoeven and Piet Verkruijsse, eds., *Iovrnael ofte gedenkwaerdige beschrijvinghe vande Oost-Indishe reyse van Willem Ysbrantsz. Bontekoe van Hoorn: Descriptieve bibliographie 1646–1996* (Zutphen: Walburg, 1996); Ogier Ghislain de Busbecq, *Itinera constantinopolitanum* (Antwerp: Christopher Plantin, 1581), which came out in a much expanded version published by Elsevier (Leiden) in 1633 that served, in turn, as the model for many later seventeenth- and eighteenth-century editions; Cornelis de Bruyn, *Reizen van Cornelis de Bruyn, door de vermaardste deelen van Klein Asia, de eylanden Scio, Rhodus, Cyprus, Metelino, Stanchio, &c mitsgaders de voornaamste steden van Egypten, Syrien en Palestina* (Delft: H. van Kroneveld, 1698); and idem, *Cornelis de Bruins Reizen over Moskovie, door Persie en Indie* (Amsterdam: R. and G. Wetstein, J. Oosterwyk, H. van de Gaete, 1714). For the travel anthologies, see Landwehr, *VOC*, esp. 99–133.

10. Balthasar Bekker, *De betoverde weereld*, 4 vols. (Amsterdam: Daniel van den Dalen, 1691–93); and J. F. Bernard et al., eds., *Ceremonies et coutumes religieuses des tous les peuples du monde*, 8 vols. (Amsterdam: J. F. Bernard, 1723–43). For examples of the sort of "literary *Kunstkammern*" that I have in mind, see Simon de Vries, *D'edelste tijdkortingh der weet-geerige verstanden: of De groote historische rariteit-kamer der sonderlinghste natuerlijcke en boven natuerlijcke saecken, geschiedenissen en voorvallen van allerley slagh*, 3 vols. (Amsterdam: Jan Bouman, 1682–95); idem, *Wonderen soo aen als in, en wonder-gevallen soo op als ontrent de zeeën, rivieren, meiren, poelen en fonteynen* (Amsterdam, 1687); and de Lange, *Wonderen*.

11. Dutch-produced atlases are excellently cataloged in Cornelis Koeman, *Atlantes Neerlandici: Bibliography of Terrestrial, Maritime and Celestial Atlases and Pilot Books, Published in the Netherlands up to 1880*, 6 vols. (Amsterdam: Theatrum Orbis Terrarum, 1967–85); for globes, see P. C. J. van der Krogt, *Globi Neerlandici: The Production of Globes in the Low Countries* (Utrecht: HES, 1993). On Dutch cartographic materials more generally, see Kees Zandvliet, *De groote waereld in 't kleen geschildert: Nederlandse kartografie tussen de middeleeuwen en de industriële revolutie* (Alphen aan den Rijn: Canaletto, 1985); and on the exotic world more particularly, see idem, *Mapping for Money: Maps, Plans and Topographic Paintings and Their Role in Dutch Overseas Expansion during the Sixteenth and Seventeenth Centuries* (Amsterdam: Batavian Lion International, 1998), which discusses "floor" maps on 211.

12. The literature on visual exotica is uneven. For Post, see Joaquim de Sousa-Leão, *Frans Post, 1612–1680* (Amsterdam: A. L. van Gendt, 1973); and P. J. P. Whitehead and M. Boeseman, *A Portrait of Dutch Seventeenth-Century Brazil: Animals, Plants and People by the Artists of John Maurits of Nassau*, Royal Dutch Academy of Sciences, Natural History Monographs, 2nd ser., vol. 87 (Amsterdam: North Holland, 1989), which covers Brazilian iconography in toto and, in doing so, details the oeuvre of Albert Eckhout, Post's colleague who specialized in

exotic still lifes and portraits. Valkenburg, Beeckman, and van Edema are still in need of biographers and catalogers, but see the brief treatment of Valkenburg in C. P. van Eeghen, "Dirk Valkenburg: Boekhouder-schrijver-kunstschilder voor Jonas Witsen," *Oud Holland* 61 (1946): 58–69. On exotic themes in decorative arts, see the relevant chapters of Hugh Honour, *The European Vision of America* (Cleveland: Cleveland Museum of Art, 1975).

13. Patterns of Dutch collecting are surveyed in Ellinoor Bergvelt et al., *De wereld binnen handbereik: Nederlandse kunst- en rariteitenverzamelingen, 1585–1735*, 2 vols. (Zwolle: Waanders, 1992), and see especially the essays of Jaap van der Veen, "'Dit klain Vertrek bevat een Weereld vol gewoel': Negentig Amsterdammers en hun kabinetten," 232–258; K. van Berkel, "Citaten uit het boek der natuur: Zeventiende-eeuwse Nederlandse naturaliën kabinetter en de ontwikkeling van de natuurwetenschap," 169–191; and Roelof van Gelder, "De wereld binnen handbereik: Nederlandse kunst- en rariteitenverzamelingen, 1585–1735," 15–38, which notes the unique Dutch habit of selling collections to foreign buyers (this in the final decades of the seventeenth century). On "hybrid" exotica—and for a rich inquiry into collecting and exotica more generally—see Martin Kemp, "'Wrought by No Artist's Hand': The Natural, the Artificial, the Exotic, and the Scientific in Some Artifacts from the Renaissance," in *Reframing the Renaissance: Visual Culture in Europe and Latin America, 1450–1650*, ed. Claire Farago (New Haven, Conn.: Yale University Press, 1995), 177–196.

14. Romeyn de Hooghe, *Les Indes Orientales et Occidentales et autres lieux* (Leiden: Pieter van der Aa, 1710), and see also (to cite but one example) Wouter Schouten, *Oost-Indische voyagie, vervattende veel voorname voorvallen en ongemeene vreemde geschiedenissen, bloedige zee- en landt-gevechten tegen de Portugeesen en Makassaren; belegering, en verovering van veel voorname steden en kasteelen* (Amsterdam: Jacob van Meurs and Johannes van Someren, 1676), which contains selections of de Hooghe's (in this case, wholly irrelevant) images in some editions.

15. Ogilby claimed authorship of a number of Dutch works—most notoriously, perhaps, Montanus's *America*—and, even when he did relinquish claims of authority, he sometimes cited original authors inaccurately (ironically giving credit to Montanus for Dapper's *Atlas Chinensis*; see below). For a case study of the intricacies of publishing early modern geography, see Isabella H. van Eeghen, "Arnoldus Montanus's book on Japan," *Quaerendo* 2 (1972): 250–272; and compare Katherine S. Van Eerde, *John Ogilby and the Taste of His Times* (Folkestone: Dawson & Sons, 1976), 95–122, which seems to have overlooked the Dutch sources of Ogilby's "great atlases."

It may also be worth pointing out how well printers in the Republic themselves poached and appropriated works of geography not originally written in Dutch—as was the case with Charles de Rochefort's *Histoire naturelle et morale des iles Antilles de l'Amerique* (Rotterdam: Arnout Leers, 1658), the Rotterdam editions of which became signal texts for later printers. See Everett C. Wilkie Jr., "The Authorship and Purpose of the 'Histoire naturelle et morale des iles Antilles,'" *Harvard Library Bulletin*, 2nd ser., no. 3 (1991): 26–84.

16. On Post and Eckhout, see Whitehead, *Dutch Seventeenth-Century Brazil*, 162–193 and passim; for the so-called "Christina atlas," see Zandvliet, *Mapping for Money*, 179–180.

17. Freedberg poses this question implicitly, in identifying a surge of Dutch natural-history writing in the later seventeenth century ("Science, Commerce, and Art"). This is also a theme broached by V. D. Roeper and G. J. D. Wildeman, *Reizen op papier: Journalen en reisverslagen van Nederlandse ontdekkingsreizigers, kooplieden en avonturiers*, Jaarboek van het Nederlands Scheepvaart Museum (Zutphen: Walburg, 1996), which pays well deserved attention to the remarkable work of van Meurs and other Dutch printers of travel literature.

18. This pertains particularly to representations of America. See Benjamin Schmidt, "Tyranny Abroad: The Dutch Revolt and the Invention of America," *De Zeventiende Eeuw* 11 (1995): 161–174; and idem, "Exotic Allies: The Dutch-Chilean Encounter and the (Failed) Conquest of America," *Renaissance Quarterly* 52 (1999): 440–473.

19. Johan Nieuhof, *Gedenkwaerdige zee en lantreize door de voornaemste landschappen van West en Oostindien*, 2 pts. (Amsterdam: Widow of Jacob van Meurs, 1682), and see 1: 20–38 and 195–211 for Nieuhof's (or his publisher's) conflation of exotic *naturalia*, and 1: 211–226 for his survey (and confusion) of exotic "races."

20. Willem Piso et al., *Historia naturalis Brasiliae* (Leiden: F. Haack, and Amsterdam: L. Elsevier, 1648); and idem, *De Indiae utriusque re naturali et medica libri quatuordecim* (Amsterdam: L. & D. Elsevier, 1658).

21. Bernard, *Ceremonies et coutumes* (and note how the first Paris imprint of 1741 actually scotched this engraved frontispiece in favor of a more "Catholic" image of the Church); Simon de Vries, *Curieuse aenmerckingen der bysonderste Oost- en West Indische verwonderenswaerdige dingen*, 4 vols. (Utrecht: Johannes Ribbius, 1682); and Joan Blaeu, *Atlas maior, sive Cosmographia Balviana*, 11 vols. (Amsterdam: Joan Blaeu, 1662).

22. Cf. Hernán Cortés, *Letters from Mexico*, trans. and ed. Anthony Pagden, 2nd ed. (New Haven, Conn.: Yale University Press, 1986), 67, 102, 105; and Montanus, *Japan*, 91.

23. Olfert Dapper's magnificent oeuvre began, it should be added, with the first-ever Dutch translation of Herodotus (1665). See further Olfert Dapper, *Naukeurige beschrijvinge der Afrikaensche gewesten, van Egypten, Barbaryen, Libyen, Biledulgerid, Negroslant, Guinea, Ethiopien, Abyssinie* (Amsterdam: Jacob van Meurs, 1668); idem, *Naukeurige beschryvinge der Afrikaensche eylanden* (Amsterdam: Jacob van Meurs, 1668); idem, *Gedenckwaerdig bedryf der Nederlansche Oost-Indische Maetschappye, op de kuste en in het keizerrijk van Taising of Sina* (Amsterdam: Jacob van Meurs, 1670); idem, *Asia: of Naukeurige beschryving van het rijk des Grooten Mogols, en een groote gedeelte van Indiën* (Amsterdam: Jacob van Meurs, 1672); idem, *Naukeurige beschryving van gantsch Syrie, en Palestyn of Heilige Lant* (Amsterdam: Jacob van Meurs, 1677); idem, *Naukeurige beschryving van Asie* [sic] *behelsende de gewesten van Mesopatamie, Babylonie, Assyrie, Anotolie of Klein Asie* (Amsterdam: Jacob van Meurs, 1680); idem, *Naukeurige beschrijving der eilanden, in de archipel der Middellandsche zee, in en ontrent dezelv, gelegen* (Amsterdam: Wolfgang, Waesberge, Boom, van Someren, and Goethals, 1688); idem, *Naukeurige beschrijvinge van Morea, eertijds Peloponnesus en de eilanden gelegen onder de kusten van Morea en binnen de Golf van Venetien* (Amsterdam: Wolfgang, Waesberge, Boom, van Someren, and Goethals, 1688); and J. C. Männling, ed., *Dapperus exoticus curiosus*, 2 vols. (Frankfurt and Leipzig: M. Rohrlachs, 1717–18).

24. Bruyn, *Moskovie*; and idem, *Klein Asia*, in which Chapter 25 is among those expressly dedicated to miscellany. On Bruyn, see Jan Willem Drijvers, Jan de Hond, and Heleen Sancisi-Weerdenburg, eds., *'Ik hadde de nieusgierigheid': De reizen van Cornelis de Bruijn (ca. 1652–1727)* (Leiden: Ex Oriente Lux, and Leuven: Peeters, 1997).

25. See, for example, the introduction by the translator to Kaempfer's history of Japan, which complains of the "large digressions" of Montanus and of the lavish plates, which are dismissed as "the greatest embellishments": Engelbert Kaempfer, *The history of Japan*, trans. J[ohann] G[aspar] Scheahzer (London: J. G. Scheuchzer, 1727), xliij–iv.

26. Smith (*Imagining the Pacific*, 23–24) makes a similar point regarding narrative ordering, though in reference to visual sources, specifically, of Dutch geography. Much the same can be said, I wish to argue, for the literary (no less than visual) texts produced at this time.

27. De Lange, *Wonderen*, sig. A2v, on bite-size exotica; J[oannes] A[ysma], *Spiegel der Sibyllen, van vierderley vertooningen* (Amsterdam: J. Aysma, 1685), sig. *3r, on disorderly organization ("in weynig regulen"); and Johan Nyenborgh, *Tooneel der Ambachten: of Den winckel der handtwercken en konsten* (Groningen: Jacob Sipkes, 1659), sig. *2, where the author quips, in Dutch as well as Latin, "Een eenig man, niet alles kan" (No one can do it all).

28. A number of authors were explicit about the importance of a visual component in geography. Kaempfer noted in his preface that "copper engravings also needed to be made [for this book], since exotica are very difficult to comprehend without the help of clarifying

illustrations": Kaempfer, *Amoenitatum exoticarum*, n.p., and see the English translation (which I have altered slightly) in Engelbert Kaempfer, *Exotic Pleasures: Fascicle III, Curious Scientific and Medical Observations*, trans. Robert W. Carrubba, Library of Renaissance Humanism (Carbondale: Southern Illinois University Press, 1996), xix. The English introduction to Bernard's *Ceremonies* likewise remarks on the essential place of pictures in geography: "no subjects stand more in need of illustration than these [geography and travel literature]; so hardly any have been ever set off with such truth and advantage." See J. F. Bernard, *The ceremonies and religious customs of the various nations of the known world*, 6 vols. (London: William Jackson for Claude du Bosc, 1733–37) vol. 4, viii.

29. Anthony Pagden, *European Encounters with the New World: From Renaissance to Romanticism* (New Haven, Conn.: Yale University Press, 1993), 51–87. Meanwhile, the "I-witness" (to adopt Clifford Geertz's pun) was making great headway in contemporary *fictional* prose—Swift's Gulliver, Defoe's Crusoe, and Montesquieu's Uzbek all claim first-person authority—just as Dutch editors were deemphasizing the traveler's position in the text. On Nieuhof's Asian narrative, which was much worked over by his Amsterdam publisher (van Meurs), see Roeper and Wildeman, *Reizen op papier*, 98.

30. Cf. Van Eerde, *John Ogilby*, 95–122, and, more generally, Adrian Johns, *The Nature of the Book: Print and Knowledge in the Making* (Chicago: University of Chicago Press, 1998), which, inter alia, seems also to misread Ogilby's title pages.

31. Baldaeus, *Malabar en Choromandel* (and cf. Churchill, *Voyages and travels*, 572); Evert Ysbrants Ides, *Drie-jarige reize naar China* (Amsterdam: François Halma, 1704) (quotation from English edition: *Three years travels from Moscow over-land to China* [London: W. Freeman et al., 1706], sig. A2v).

32. Schouten, *Oost-Indische voyagie*, 44–45. If one had to point to an "enemy" in Dutch geography of ca. 1700, it would be the Portuguese, an antagonist widely acceptable to the "new" imperialists of Enlightenment Europe. Virtually no text produced in the Republic was ever translated into Portuguese, in any event, nor were the products of Dutch geography apparently marketed for Portuguese consumption.

33. François Valentijn, *Oud en Nieuw Oost-Indiën*, 5 vols. (Amsterdam: Gerard Onder de Linden and Dordrecht: Joannes van Braam, 1724–26), which includes a subsciption list of some six hundred buyers. On prices of luxury books, see Landwehr, *Studies in Dutch Books* (81 for Valentijn's geography). Data on wages—from 9 to 11 Dutch guilders per month for a VOC sailor (or soldier) and about twice that amount for an officer—are taken from Femme S. Gaastra, *De geschiedenis van de VOC* (Zutphen: Walburg, 1991), 91; and see also Jan de Vries and Ad van der Woude, *The First Modern Economy: Success, Failure and Perseverance of the Dutch Economy, 1500–1815* (Cambridge: Cambridge University Press, 1997), 607–32.

34. Dapper, *Syrie en Palestyn*, 19; idem, *Gedenckwaerdig bedryf*, plate facing 459 ("Verscheiden slagen van bonetten"); Nieuhof, *West en Oostindien*, 2: plate facing 31 ("Nagelboom"); Kaempfer, *De beschryving van Japan: behelsende een verhaal van den ouden en tegenwoordigne staat en regeering van dat ryk* (The Hague: P. Gosse and J. Neaulme, and Amsterdam: Balthasar Lakeman, 1729), plate no. 39.

Shopping for Instruments in Paris and London

JAMES A. BENNETT

On 8 December 1768, Jean Bernoulli wrote from London:

> I've been here in London for eight days. I am still not able to tell you about astronomers or observatories, but I will share the pleasant surprise which strikes an astronomer walking through the streets of this capital. You have surely heard talk of the richness and brilliance of the shops of London, but I doubt whether you can imagine how much astronomy contributes to the beauty of the spectacle: London has a great many opticians; the shops of these artists are full of refracting and reflecting telescopes, octants, &c. All these instruments, ranged and set out with care, strike the eye at the same time as imposing reflections on the mind.[1]

He was astonished, and was confident that his correspondent would share his astonishment, that he could continue his report on the state of astronomy in Europe without yet having visited such conventional sites as observatories, academies, and the homes of astronomers. He was not surprised that instrument making flourished in London: that was well known to anyone active in practical astronomy in the eighteenth century, when London instruments were being used in observatories all over Europe. His correspondent also was familiar with this, as Bernoulli introduces the famous names as though he had met in the flesh some shared object of distant curiosity and admiration ("You know very well the name of M. DOLLOND, the celebrated artist").[2] Instead what surprised him was the commercial context for all this astronomy: the vulgar but dynamic and exhilarating world of the London shops—of Fleet Street, the Strand, Haymarket, and Piccadilly. What business did astronomy have to display its apparatus in such a context? And the display was not confined to the famous names he had known from their publications and exported instru-

ments: there were evidently a great many more makers of unknown reputations, but whose shops seemed similarly to be filled with organized presentations of telescopes and octants. It was clear from the very first impression that the experience of an astronomer shopping in London would be very different from one in Paris.

We have become familiar with the idea that over the course of a century or so, a "public" science had been established by the later eighteenth century, and the ingredients commonly cited in its formation include societies, coffeehouses, lecture courses, museums, polite or rational entertainments, and popular books. This chapter will look at shopping for science in the seventeenth and eighteenth centuries, at the nature of the interaction between buyer and retailer, and at how and where their transaction was conducted. We will use the experiences of foreign visitors: they notice and remark on what strikes them as unexpected and distinctive, drawing attention to things that locals pass over as unremarkable and taken for granted.[3]

MONCONYS, VON UFFENBACH, AND LALANDE IN LONDON

Our first shopping visitor to London arrived in May 1663. He was Balthazar de Monconys, who was accompanying the duc de Chevreuse on a tour of Europe at the behest of his father, the duc de Luynes.[4] Monconys was a member of the Montmor Academy in Paris and was keen to meet fellows of the Royal Society: he tried to find Henry Oldenburg as soon as he arrived in London. He was an active, enthusiastic, and perceptive observer of the English scene, who deliberately set out to experience as much as he could manage, filling his days with the rich and colorful life of London — the manners of the court, the bookshops of St. Paul's, the workshops of instrument makers, the public prize fighting and bear baiting. More than anything he was taken by all kinds of "ingenuity" in London, by the activities of the Royal Society, and the inventions, experiments, and "secrets" of its fellows. His chief guides were Oldenburg, Robert Moray and William Brouncker.

On his first day in London, before he had met any of these guides, he bought a telescope from a maker close to the Royal Exchange. In the days that followed he visited more shops, bought more telescopes, and on his third day in London, before he had found Oldenburg, he made his way to Richard Reeve's workshop in Longacre, to which he had been particularly recommended. No telescopes were in stock, such was the demand, but Monconys was shown something that astonished him. He attended a demonstration of a magic lantern. It is clear from his careful description that he had never seen such a thing before — indeed his description became one of the very first published accounts of the magic lantern. He has no shortcut vocab-

ulary to deploy, but must describe the process with deliberation; the slide, for example, is "a glass 'leaf' on which the objects are painted."[5] Not only does Monconys give us what seems to be the first recorded English instance of a magic lantern, but more important for our purposes, his account shows that more things could take place in the shops of instrument makers than buying and selling: already they could be the sites of public demonstrations in natural philosophy.

Monconys continued to visit shops and to buy instruments, while becoming caught up in the life of the London virtuosi. He began to attend meetings of the Royal Society on 13 May—an important occasion for the new society, since it was the day when the royal charter was read to the council—and returned to his lodgings by way of Reeve's shop, to see his range of microscopes. He was back at the society the following week. He met Robert Boyle then, and visited and admired Boyle's laboratory, noting his very good telescopes and two excellent microscopes. He attended the society again on 27 May, and this time the Journal Book records him contributing to the discussion. He visits other laboratories and workshops, and ventures as far as Stratford Bow to visit the inventor Johann Küffeler, where he saw a self-regulating "philosophical furnace" for experiments in natural philosophy.

Monconys records all these encounters with evident relish and enthusiasm. He was on an odyssey of discovery. Boyle tells him about dissecting the frozen eye of a bull and describes in detail an experiment of his demonstrating the weight of the air. Monconys buys sixty-six examples of what he calls "glass teardrops," known in England as "Prince Rupert's drops"—small glass vials with unusual mechanical properties that the Royal Society had investigated at the king's request and of which Robert Hooke was to publish an explanation in his *Micrographia* of 1665. The following day Monconys sees a special design of pendulum clock at Moray's house, goes with him to the laboratory of Nicaise le Fèvre, former chemist at the Jardin du Roi and now apothecary to Charles II, and from there to Oldenburg to discuss the last meeting of the Royal Society. A few days later he buys eighty-four more of the glass teardrops.

Monconys was delighted to be involved in this activity. When Samuel Sorbière, secretary of the Montmor Academy, visited London at the same time and sought out Monconys, he says, "I found him in his element, immersed in the conversation of natural philosophers and breathing nothing but machines and new experiments"[6] The shops of certain makers were an integral part of this world. When Monconys returns to Reeve's to see his microscopes, he also engages him in discussion and learns, for example, something of the technique of working gems.

Other instrument makers visited by Monconys were Ralph Greatorex, to whom he entrusted a loadstone for "arming"—that is, fitting with iron pole

pieces to enhance its magnetic properties—and Anthony Thompson. He wanted Thompson to make him an example of Christopher Wren's perspectograph, even though he could not have it ready in less than fifteen days, by which time Monconys would have left England. Monconys arranged for Oldenburg to send it on to him, which he did in November 1664, but it arrived in Paris shortly after Monconys died.[7]

There are a number of things to be learned from the record of Monconys's experience in London. He was keen to acquire London instruments, and there were a number of makers to choose from. Among those Monconys visits, some—in particular Reeve, Greatorex, and Thompson—are clearly linked to members of the Royal Society and are an integral part of the virtuosi culture of London. Monconys is aware that Reeve's collaboration is central to the efforts of Goddard, Paul Neile, Moray, and Wren to develop the long refractor, efforts that had attracted the personal interest of Charles II. When Oldenburg reported observations of a transit of Mercury to Boyle in October 1664, he said that "Our Virtuosi did observe both at Gresham [College] and Mr Reeve's".[8] We know that on the occasion of an earlier transit, in 1661, Christiaan Huygens was among the observers at Reeve's shop.[9] There is evidence that Thompson's shop in Hosier Lane, Smithfield, was also a recognized meeting place, and Monconys knew that he had made the original example of Wren's perspectograph.[10] Greatorex too was one of the makers closest to the Royal Society and had worked for Wilkins, Goddard, and Boyle.

We have seen that Monconys does not only transact business with Reeve: he records things he learned from his discussions with him, and it is particularly striking that Reeve has a demonstration to offer his visitors. It is important in this context that Reeve has a shop—a business address that is more than simply a workshop. His address is known; Monconys can go there and be received before he has met his Royal Society contacts. This is a commercial space that is in the public domain, but it is a site also for the exchange of intelligence in natural philosophy and even for observation and demonstration of the kind normally associated with the Royal Society.

In these London shops there were off-the-shelf items that could be had immediately, but for more unusual instruments from the best makers, the customer would wait while his order was attended to. This was not always successful: Monconys was promised by a glassworker that he could have an example of Wren's circular thermometer—an instrument that could be made self-registering—but on returning several days later, he was disappointed. This is not surprising: it was a very unusual instrument, requiring critical shaping and balancing. Even this phenomenon of delayed orders and returning visits is linked to the different uses of the shop space. The visitor might come back not only to see or receive his completed instruments, but also or alternatively to see finished work for other customers or for stock,

and a more advantageous time for a visit could be predicted on the basis of progress in the workshop. This reinforced the idea of the shop as a place of resort, where instruments and production techniques could be viewed and discussed, while the visitor's growing familiarity with the maker and his premises added to the impression of a semipublic space where he and other visitors had an interest shared with the maker himself. Monconys saw Reeve several times, and records being given specimens of materials, but so far as we know he bought nothing.

These characteristics of the London trade had developed significantly by the time the collector, connoisseur, and traveler Zacharias Conrad von Uffenbach of Frankfurt-am-Main came to London with his brother in 1710.[11] He visited the shops of John Marshall, Edmund Culpeper, John Patrick, John Rowley, and Francis Hauksbee, all of whom are remembered today as talented and original makers. In each case he seems to have gone by coach deliberately to the premises of a known maker at a known address. On one occasion they "intended to wait on" Rowley, but he was not at home.[12] On another they failed to find "the shop of the famous mechanician Moxon."[13] The Moxon who could most reasonably be described as "famous" was Joseph, who had died in 1691, but could well have had a continuing European reputation through his publications. His son James succeeded to the business, but the last record of him trading dates from 1703.[14]

Von Uffenbach's brother persuaded Marshall, on payment of 7 guineas, to teach him the art of glass cutting, not because he thought Marshall was particularly skilled in this direction—he did not—but because he was curious to learn the English practice. As a result the brothers made frequent visits to Marshall's shop, usually in the afternoons, for these practical lessons. They bought some small telescopes, and were taken by Marshall's method of demonstrating their quality: he "had had his name placed in white on the roof of a house some twenty houses from his own," which could be read easily with one of his telescopes.[15] From Culpeper, von Uffenbach bought a number of fairly routine items—an architectonic sector, a magnet, a microscope, a spyglass, a drawing pen, and an oval reading glass—but Culpeper could not help the brothers in their quest for an example of Samuel Morland's calculating machine. At Patrick's they saw many different kinds of barometer, which von Uffenbach describes in detail, while mentioning which are new inventions and what were their particular advantages, so they must have spent some time viewing and discussing them, but they seem to have bought nothing.[16]

They did buy a telescope at "an optician's called James Praun," and they asked him to repolish the lenses of instruments bought from Culpeper. It is curious that no James Praun or anyone with a name that might be so construed is known to have been trading at the time. In von Uffenbach's view

"This man is very cheap and good and, if he takes the trouble, makes a fine polish,"[17] but we must remember that he had judged Marshall's talents with glass inferior, even though he knew that "everyone makes a great to-do over him and his work."[18] Von Uffenbach's judgment reflects on his engagement with instruments, and in any case the whole account of his visit to London reminds us that he is a general connoisseur, collector, and dilettante. The telescope he buys from Praun is in keeping with this. It is a refractor with five lenses, a shagreen covered body and a number of draw-tubes. The lenses and tubes can be configured in four different ways, to yield different telescopes, which von Uffenbach describes. This delight in ingenuity, often taking the form of a multipurpose instrument that can be variously configured, was a familiar ploy to catch the dilettante shopper.

When von Uffenbach did find Rowley in, he was willing to make Morland's calculating machine for 5 guineas, but none seems to have been ordered. Rowley, who was a very resourceful and original maker, showed the brothers some long object glasses between 15 and 18 feet focal length, that he was not willing to sell. One interesting thing we learn from von Uffenbach, which does not seem to be known otherwise in the history of the telescope, is that Rowley was making a Newtonian reflector. It is generally thought that the only such attempt between Newton himself and John Hadley in 1721 was by Francis Hauksbee, who was closely associated with Newton. Although the details are slight, it seems likely that the objective mirrors were made of glass, to be silvered: von Uffenbach introduces them in the context of the long focal length objective lenses, says they are "convex-concave" and compares their polish with that of the lenses. Silvered glass mirrors for telescopes came into general use only much later but the idea was around in the early eighteenth century: John Pound mentions it as a possibility in 1723, and James Short was making such mirrors in 1734. Both Newton and Hadley used metal mirrors. Rowley valued his objective mirrors highly—at 7 or 8 guineas each.[19]

So the pattern of transactions in the shops of the makers is becoming familiar. Viewing of original pieces, discussion with the maker, instruction, and demonstration are all part of practicing the trade on the one hand and polite shopping on the other. Makers with substantial reputations were particular targets, even if such shoppers were prepared to buy elsewhere. Von Uffenbach was especially fortunate to have seen a Newtonian telescope under construction at Rowley's, and to have listened while "he praised this invention of Newton very highly, as though it were quite matchless." But he still recorded his disappointment that "there were no other instruments completed at the moment, which is greatly to be regretted, since he is considered one of the best mechanicians in England."[20] Rowley's name is found on a great variety of surviving instruments, and it is difficult to imagine that

he had nothing in his shop beyond a few lenses that were not for sale. It seems more likely that von Uffenbach is ignoring the standard and routine instruments: this aspect of the shopping experience related to the original, ingenious, or ornate piece, an instrument worth a special visit, one for which the maker himself had a direct responsibility and that was not simply made or bought in as an item of stock.

Von Uffenbach witnessed the most developed example that London had to offer in this rise of polite shopping when he visited the premises of Francis Hauksbee. Hauksbee was the maker closest to the Royal Society, being employed as a demonstrator to provide experiments at the meetings. He took these experimental demonstrations from the society into the public realm with his subscription series of lecture/demonstrations, at first in collaboration with James Hodgson.[21] By 1710 Hauksbee was offering the courses on his own, and von Uffenbach's account suggests that experiments would be performed for private visitors as well as within the lecture course; we cannot be certain of that, but there is no suggestion that the audience was larger than the two brothers.

The first time they visited Hauksbee's premises in Wine-Office Court, Fleet Street, it was not by appointment, since "we did not find him in." Clearly they treated Harksbee's address like that of a shop, where they could expect to be received on demand. They were not entirely disappointed, as Hauksbee's young "cousin"—probably his nephew, also Francis Hauksbee, who was later involved in a rival lecturing enterprise—"took us up and showed us some common experiments." They then made an appointment and bought a copy of the elder Hauksbee's *Physico-Mechanical Experiments* (London, 1709), "so that after studying it at home, we might see the experiments again with great profit."[22]

When they returned, they were in the hands of a master philosophical showman: "We saw with amazement his excellent demonstrations and experiments, especially those relating to the nature of light, which were certainly very excellent and curious." Von Uffenbach followed the experiments from Hauksbee's book and was enchanted by his skill in carrying off a whole series of pneumatic demonstrations in a virtuoso display on the air-pump. Hauksbee was practiced at drawing his audience into the experiments, getting them to test the effect on the phenomena of rubbing the evacuated vessel with their fingers, or breathing on it.[23] Here is a telling early example of the commercial talent and technique of a new breed of philosophical entrepreneur: the combined use of the illustrated textbook and the demonstration to engage the potential customer for examples of the apparatus in use. Hauksbee derived income from courses and publications, but his principal aim was to sell the products he manufactured. To do so he had first to create a new market, and the policy he adopted was to transfer

to his shop—with only slight modification—the traditional experimental performance demanded formerly of Robert Hooke and now of himself at the Royal Society.

An unfortunate imbalance is already evident: we are much better supplied with foreign instrument shoppers in London than in Paris. For the end of the seventeenth century, we do have Martin Lister's visit to Paris: he is interested in various trades, but he takes little notice of instrument makers. In fact the only one who figures significantly is Michael Butterfield, who was "a right hearty honest Englishman, who has resided in France 35 years."[24] Butterfield is a further example of a maker conducting experimental demonstrations on his premises—in this case with his large collection of lodestones—but it is clear that this is not typical of the Parisian scene.

The imbalance simply reflects the state of affairs in the period: informed observers did not go to Paris to shop for instruments. Long ago Maurice Daumas noted that the Parisian makers served "a small, local clientele," which he identified as the royal court, the salons of a few wealthy individuals, and the cabinets of several colleges.[25] There was practically no export trade, and the local market would not witness the consumer expansion that in England would give the hardware of natural philosophy a place in many well-to-do homes. It is only toward the end of the eighteenth century that a few visitors to Paris indicate the beginnings of a revival in the French industry.

But French visitors to London can be an indirect comment on Paris, because of the unfamiliar things they note and the contrasts they draw. Lalande came to London in 1763, the visit being in itself a comment on the relation of English to French work in precision mechanics, for his mission was in part to discover as much as he could about the chronometers of John Harrison, and in part to investigate the acquisition of astronomical instruments.[26] He was certainly struck by the vitality and confidence of the mechanical scene in London, by the distinctive and visible presence of a dynamic group of practitioners, and by the acceptance of some of them into the Royal Society. For some, such as the leading makers of astronomical instruments, involvement with the Royal Society was important, but it must be remembered that the makers had other institutions and associations and were more than able to take independent initiatives. Historians of science tend to focus on the Royal Society as the source of intellectual and cultural patronage, but it is far from clear that it had an exclusive prominence in these respects for the makers. Nonetheless, Lalande found the easy relations between *savants* and *fabricants*, between *sciences abstraites* and *sciences appliquées*, different, refreshing, and positive.

Lalande spend a good deal of time with James Short, and also with John Bird and Francis Watkins. He discussed polishing techniques several times with Short, who was his principal link to Harrison. On one occasion Short

confided that giving a mirror a parabolic shape—and his reputation rested particularly on this supposed skill—was a matter of touch, not science: "it's only by feeling one's way."[27] Lalande was entertained several times by Watkins and described instruments he saw there. He also visited Jeremiah Sisson more than once and viewed his instruments. It may have been from Watkins that he learned that Sisson had gone to prison several times for not paying his workmen, and that failure to complete instruments had led him to pawn others, only to see them sold well below their market value.[28]

Bird, he discovered, would charge 1,200 French *livres* (equivalent to 50 guineas) for a quadrant of 18 inches, half to be paid in advance, and 350 pounds sterling (8,000 *livres*) for an 8-foot quadrant—that is, one like the mural instrument he had built for Greenwich. Packing would be an additional 10 pounds, and the delivery time would be two years.[29] Lalande had learned at Sisson's that it was Jonathan, rather than his infirm father, Jeremiah, who had made several well-known quadrants, including that of his mentor Pierre Charles Le Monnier; at Bird's, on the other hand, Bird told him that he had seen complaints about Sisson's work.[30] No doubt, after the order from Le Monnier and in view of Le Monnier's increasing promotion of English instruments, Lalande was seen as a serious possible source of a significant commission, so the rivalry between Bird and Sisson was understandable. A week later Bird was able to play an important card: Lalande had breakfast at Bird's with Thomas Hornsby, professor of astronomy in Oxford, and they went together by boat to Greenwich to examine the instruments there; both Bird's guests were shopping for quadrants, and both would eventually buy small and large quadrants from Bird. Lalande placed his first order two weeks later, for an 18-inch quadrant, paying the stipulated 25 guineas in advance.[31]

Lalande introduces us to some new features of the London scene. No ordinary shopper, he was favorably placed as a fellow of the Royal Society, and he carried the promise of a significant commission. His shopping technique included spending a long period in the astronomical community of London—makers and astronomers. At the same time, the situation of the makers was changing. The success of Graham's instruments at Greenwich, including the first empirical proof of the motion of the earth and the setting of a new foundation of accuracy in positional astronomy through the discoveries of aberration and nutation, had set the elite makers of precision instruments on a path that would progressively raise their status above that of the rest of the trade. Sisson and Bird had begun to reap the benefits through the beginnings of an export trade in astronomical instruments.[32] Bird would became even better known through the Board of Longitude's endorsement and publication of his construction methods.[33] But he was already able to take distinguished shoppers to the Greenwich Observatory—the perfect showroom for his quadrant and transit instrument.

Lalande's elevated position also reveals to us an aspect of the trade in instruments of natural philosophy that we have not encountered before. He went with Dr. John Pringle, physician to the queen and later to George III, to see the royal collection. According to Pringle, George had told him that he knew Lalande's works. The king was going to Richmond but had left orders that the air pump designed by Smeaton was to be made ready for Lalande, and it was George Adams, the maker of the pump and instrument maker to the king, who had the considerable task, according to Lalande's account, of getting it to work. Princely patronage for instrument makers was not typical of the London trade, but it did exist.[34]

BERNOULLI, BUGGE, AND VAN MARUM IN LONDON AND PARIS

Three of our travelers from the later eighteenth century go both to London and to Paris. The first is Bernoulli, whose surprise and delight at the vibrancy of the commercial trade in London in 1768 we have already seen. Some of the practices we have encountered with Reeve and Haukbee are now being pursued vigorously by Benjamin Martin. Bernoulli and his correspondent already know Martin's name through his publications. His shop is one of the best stocked, and he has a clientele eager for his courses on mechanics, experimental physics, and astronomy, all made doubly interesting by the beautiful instruments used for illustration. Bernoulli himself attended "with pleasure" a lecture on the forthcoming transit of Venus, where Martin used a large animated diagram on one wall of the room, which represented the progress of the transit, as it might be visible in London, up to the time of sunset. This was a "virtual" experience offered in a room of Martin's shop, available daily with no disappointment from bad weather. Bernoulli is very taken by this, and in general gives the impression of a popular, thriving, and innovative business in natural philosophy.[35] Although he judged that Martin's twenty or so books had been very well received, not everyone had been impressed. It is perhaps an indication of the circles Lalande had moved in that he had been told in 1763 that Martin "gives courses in physics ridiculously."[36]

Opposite Martin, and also well known through his publications, was Adams, who had a great number of instruments of physics, mathematics, gnomonics, and astronomy. Henry Pyefinch also had a very well-stocked shop, and Edward Nairne is mentioned as a well-known maker of telescopes and other instruments. Short has died, and Bernoulli attends the sale of his instruments.[37]

Of the mathematical instrument makers, three rivals stand above the others, and among them Bernoulli believes their reputations to stand in the

order: Bird, Sisson, and Jesse Ramsden. He has clearly spent time talking to Bird and Sisson, but not Ramsden. He does describe in detail a telescope mount by Ramsden, but he may have seen this in Dollond's workshop. Among other things, he has discussed with Bird the application of achromatic lenses to divided instruments and with Sisson his method of dividing scales—a point of interest because Bird's method had now been published by the Board of Longitude, and Sisson had been trained by his own father, who had also trained Bird. For the well-informed shopper the history and workshop traditions of the London makers already fall within the orbit of connoisseurship. Bernoulli is aware of Bird's latest foreign commissions—clearly considered a mark of his distinction—and while his instruments are judged the finest, they are also the most expensive.[38]

One of the most useful aspects of Bernoulli's record is the negative report he writes on Dollond, because it illustrates part of the increasing complexity of commercial practice. Bernoulli has been to Peter Dollond's workshop: it is large and its products cover a wide range—reflecting as well as refracting telescopes, and almost all the types of optical and astronomical instruments used in England. The more valuable instruments are available only to order. It is helpful that, while the word "shop" is ambiguous in English in this period, in French Bernoulli has three words—"atelier," "boutique," and "magasin"—that he can deploy more precisely, and at this point we know he is talking about Dollond's workshop, "atelier." (Martin, Adams, and Pyefinch each have a "magasin"—a shop of a larger size than a "boutique.") For the instruments made in quantity, he cautions that people who buy English work imagining that the signature "Dollond" is enough to ensure excellence are seriously mistaken. Indeed, if they are fortunate enough to get a good instrument, this means that it was not made by Dollond's workmen at all, but that at least part of the work has been subcontracted to his brother-in-law Ramsden.[39]

Whatever the rights of Bernoulli's opinion of Dollond's workshop, we have learned that by 1769, at least in the larger enterprises, a signature does not identify the work of the master; it does not even necessarily identify the workshop where the piece was made. It has to be said that Bernoulli was not impressed by Peter Dollond, because he did not have the theoretical knowledge of his father, John. It was surprising, wrote Bernoulli, that he had managed to achieve so much in achromatic lenses on the basis of trial and error. He did not, of course, hear this from Dollond, but had been assured on good authority that a great many lenses of crown and flint grass were manufactured and successful combinations found simply on the basis of trying them out. Bernoulli did, however, have his own experience to add to this. Extraordinarily, he posed a series of questions to Dollond, questions that had been set beforehand by Béguelin. It is not clear whether Dollond realized that he was sitting an examination, but he definitely failed.[40]

Despite all this, the only purchases Bernoulli records making were of three lenses from Peter Dollond. Dollond held the patent for achromatic lenses, which is part of the explanation for widespread resentment among other opticians, as well as for the questioning and probing from foreign visitors, who believed that the theoretical advantage lay with Continental mathematicians. Sometimes shoppers were obliged to buy from a certain maker for reasons other than choice. Bernoulli could not be completely sure of the significance of Dollond's examination failure: either he could not or he would not answer, but either way he did not feel obliged to cooperate with Bernoulli's stratagem. Perhaps the strength granted to him by the patent meant that he did not need to cultivate shoppers in the fulsome manner Bernoulli had enjoyed elsewhere.

Bernoulli left England for France in May 1769, and he sees the mural quadrants by Bird and Sisson in the observatory of Le Monnier. He says he has little new to report concerning the makers of astronomical instruments. They are not as good as the English makers, who particularly excel in divided instruments, but he can at least mention Langlois and Canivet for producing distinguished work. There are amateur lens makers producing good achromatic objectives for telescopes, but no "Artists by profession." The only shop he mentions is that of Passemant, where good reflectors and refractors can still be found, though his report seems not to be firsthand. Throughout, no maker is reported as having said anything to Bernoulli: at least so far as his letters are concerned, the Parisian makers are silent.[41]

The visits to London and Paris made by the Danish astronomer Thomas Bugge were separated by some twenty years, so we will look first at his experiences in London in September and November 1777 and separately at his time in Paris. In London he visited the shops of many makers, buying books and instruments, and enjoying conversation and experiments.[42] Adison Smith "at the golden quadrant" in the Strand, who in 1764 had been one of the petitioners against the patent for achromatic lenses held by Peter Dollond, told him the makers' account of the priority of Chester Moor Hall, while taking his order for a triple prism to demonstrate Dollond's technique.[43] On his visit in 1763, Lalande also had heard of the claims on Hall's behalf from John Bevis and Short. Bugge may have caught the flavor of this dispute, for he later noted, having visited the premises of both Peter Dollond and his brother John, that "none of the Dollond brothers seems to have any theoretical knowledge."[44] It was precisely Peter's contention that any earlier lens combinations that may have existed were made empirically and not on the basis of any theoretical understanding.

Some instruments Bugge could buy directly from stock—a rule from Smith, for example, comparing English, French, Dutch, and Antwerp measure, or Dollond's form of rolling parallel rule.[45] Martin's shop was "well-

supplied," and he bought a number of books there.[46] He was particularly taken with Nairne & Blunt, finding Edward Nairne a "splendid man," who could show him "many excellent objects"—a new kind of marine barometer, a dip circle, different sorts of theodolites, and a new telescope mount.[47] He returned so that Nairne could show him a number of experiments with his electrical machine, and he ordered one.[48]

Bugge was very taken with the watchmaker Alexander Cumming, buying his book on the *Elements of Clock and Watch Work*, admiring his barograph, and hearing the details of the construction of different types of compensation pendulum. Cumming showed him the observatory he had at the top of his house, with a transit instrument and an equatorial, both by Ramsden.[49] Bugge later returned and "examined his barometric clock very closely," learning along with the design details that the price for such a clock was 500 pounds.[50] On his visit to John Arnold he was told of his improvements to chronometers, was shown a demonstration of the effect of temperature on a balance spring, and made an appointment to view experiments on different types of compensation pendulum, which took place the following week.

Bugge discovered that Arnold had a transit instrument that had formerly belonged to George Graham.[51] Sisson described to him an observatory designed for Nathaniel Pigott, and showed him a transit instrument to be installed there.[52] Here as elsewhere, details of the design are carefully explained and recorded, especially where there are new ideas. These were particularly evident at Ramsden's shop in Piccadilly, where he was shown an 8-foot quadrant being constructed and noted "Ramsden's ideas about some new instruments."[53] George Adams was able to show him a transit instrument he was making for the king's observatory at Richmond.[54]

Bugge spend some 88 pounds on instruments and associated apparatus, as well as 34 pounds on books. The most expensive items were a compound microscope from Dollond at 8 guineas, lenses from Smith at 8 pounds, 9 shillings, and a range of things from Nairne and Blunt: a hydrostatic balance (7 pounds, 17 shillings, 6 pence), an electrical machine (13 guineas), a battery of nine Leiden jars (4 guineas), a mechanical model (mechanical powers) (21 pounds), and an air pump (11 pounds, 15 shillings). Nairne was able to show Bugge the instruments made for him on his last day in London, and he "found them all very pleasing."[55] He also bought a set of drawing instruments from Adams at 2 guineas.[56] It is worth emphasizing that he returned twice to see more extensive experiments—in Arnold's case certainly by appointment, and probably in Narine's as well, to judge by the extent of the experimentation and the careful notes taken by Bugge.

In July 1785 Martinus van Marum of Teyler's Museum in Haarlem was in Paris, visiting physical cabinets, attending sessions of the *Académie des sciences*, witnessing the therapeutic applications of electricity, and so on—

thoroughly occupied with the French practice of natural philosophy.[57] He is particularly interested in electricity and is curious to see the use of a machine by Nairne. It is clear that there is plenty for him to do and see and that, while there is a growing vitality that is less commercially based than in London, there are also occasional similarities to London. Courses of lecture-demonstrations continue in the tradition of Nollet, generally not conducted by makers themselves, but using a wide range of instruments. Roulant was the successor of the better-known Sigaud de la Fond and was in the middle of moving when Van Marum visited him, so not much of the collection was visible, but he did say that he had held thirteen courses in physics the previous year.

However Van Marum does visit one shop—that of Bianchi (or "Bianchy") in the fashionable shopping street the rue Saint-Honoré. As an Italian who had previously plied his trade in Amsterdam, Bianchi was something of an interloper in the Parisian scene, but he brought with him practices of the Anglo-Dutch variety that linked experimental demonstration with making and trading. Bianchi probably began as a glass worker and barometer maker in the Italian tradition, and it was the use of blown glass in electrical machines that occupied the conversations and demonstrations that engaged Van Marum and himself, continued by arrangement into a second day. We know separately that Bianchi advertised himself as a demonstrator in physics, conducted courses on experimentation in electricity, and supplied a wide range of experimental apparatus, including electrical machines, air pumps, barometers, thermometers, microscopes, and telescopes.[58] This was a real shop in the London sense—a space where the maker cultivated the customers' interests, engaged them with impressive experiments, offered them courses to deepen their commitment, and sold them philosophical instruments.

This was a single instance, the initiative of an enterprising immigrant. Otherwise, Van Marum is very largely engaged with visiting the many private cabinets; these give him his principal visual impression of natural philosophy in Paris. When he comes to London in 1790, he seems to be less motivated to make a full record of his activities, but in only a few pages of notes covering three weeks, which trail off into mere jottings, instrument makers and their shops are a prominent and recurring feature.[59] Not all are named, but the better known among those who are are Nairne, Adams, and Haas. Van Marum visits Tiberius Cavallo, who uses his extensive cabinet of instruments for a series of demonstrations. Although not generally seen as a maker, Cavallo incorporated a commercial dimension into his performance, as he takes an order for four pieces from Van Marum and will have them made. Also an Italian, his situation is not very unlike that of Bianchi in Paris.

Otherwise, the conduct of Van Marum's shopping in London is familiar to us. He returns by appointment to see more with Adams, Nairne, and Dol-

lond. Adams was rewarded by an order for a complete table planetarium with lunarium and tellurium. Nairne "requested us to come again the next Wednesday, when he expected to have some new instruments on hand," while at Dollond's "we received from him the promise that he would show us another day what he had ready." Van Marum also went twice to Haas, but by this stage his notes are very sketchy. These visits fall within the pattern we know already of the London trade in relation to specialist shoppers. Perhaps the only new fact of commercial interest we learn from Van Marum is that Nairne is sufficiently prosperous to have a country house.[60]

J. D. Cassini offered an analysis of the French situation in relation to the English—in effect Paris in relation to London—as he saw it when he took over the directorship of the *Observatoire de Paris* in 1784. He was deeply dissatisfied with its prospects, particularly on account of his instrumentation. The famous expeditions of the past had created an enthusiasm for instrumental improvements and had encouraged the talents of French makers, but they had now been left far behind by the English, whose technical and commercial dominance could not be ignored.

> The Observatory was then equipped with mural instruments, with large movable quadrants, the work of Langlois, of Canivet, of Lennel, who were in those days the most celebrated makers of astronomical instruments. But at the time I took over the direction of the Observatory, these old talents had been eclipsed by those of Bird and Ramsden, English artists who had carried their art to the highest perfection, leaving the French far behind them, from whom they had usurped the trade in optical and mathematical instruments almost entirely.[61]

Cassini's analysis is instructive, as is the proposal he offered to remedy the situation. French makers, he was sure, were not inferior in talent or education; the problem lay in commerce, not in mechanics. The French makers could not get a fair price for their products: French customers would not pay a fair price for French instruments. Yet at the same time he expected them to pay as patriots, rather than as shoppers. Caught up in an "antipatriotic mania," they behaved as though they were buying lengths of cloth:

> How often have I been offended by people who, begging me to procure a good instrument for them, haggle as if it were a length of cloth. What will it cost? I was asked; not as expensive, surely, as an English instrument?

> Why not? I replied; do you want to be fair? if the instrument is worth nothing, don't take it: but if it is good, pay what the maker will ask, even if he were to make you pay more than for an English one.[62]

In fact it was impossible, he said, for a maker in Paris to produce the same instrument for the same price as one in London, and for three reasons: they did not have the means and the appropriate machinery, they did not have the capital to fund the first stages of construction, and they were the victims of the "Anglomania" that created a preference for English instruments.

Cassini's solution, however, was more French than English. He did not argue for, say, the abolition of the restrictive practices of the corporations, whose activities were particularly detrimental to a manufacturing trade which, if it was to progress, had to be able to bring together different skills and combine a variety of materials. He did not try to imagine how he might encourage a broader-based consumerism with respect to mathematics and natural philosophy, as his jibe about shopping for cloth makes clear. Rather he proposed the establishment of a kind of national workshop at the *Observatoire*. Here the machines that individual makers could not afford to buy would be made available to them. Two or three promising mechanics would be sent for training in the great workshops of London, to be employed in the national workshop on their return, and to maintain the momentum of improvement the workshop should be given an annual subvention from the government.

Cassini's analysis of the differences between makers in Paris and London was largely accurate, but in London capital for the machines needed for efficient production and capital for large, prestigious, and innovative instruments were generated by commerce in smaller, everyday instruments, and by the entrepreneurial development of forms of shopping that made buying instruments not so very different from buying cloth. Of course, London makers had this commercial opportunity because they were in the middle of a broader consumer revolution among the English bourgeoisie, and they could hitch themselves to this engine of capital production. But in doing so, they had taken risks that Cassini did not feel could be expected of the Parisian makers: John Cuff and Benjamin Martin were among a number declared bankrupt. Martin even committed suicide.

The workshop and an associated foundry were established at the *Observatoire* but were not successful. Yet, just as the project seemed to be faltering, Cassini had the opportunity to go to London on a plausible and legitimate mission that would take him into the heart of the instrument world. The meridians of Paris and Greenwich were to be linked by a collaborative geodetic enterprise, with Cassini in command of the French component. He would have to go to London to make the necessary arrangements, as he explained to the minister: "I will go to see these superb English instruments,

to examine these masterpieces of the art, and these models which it is our first ambition to imitate in France. I will have occasion to see and to cultivate Dollond, Troughton, Ramsden."[63] He was particulaly anxious to cultivate Ramsden, for by now his reputation was unrivaled, and it was in his workshop that he hoped to place the two or three chosen Frenchmen. How could Ramsden be persuaded of such a plan? Cassini sought permission to order an instrument from him, having no doubt that he would be suitably mollified by receiving such a commission: "without doubt he will be flattered to work for the Observatoire Royal de Paris, where there is still nothing by him."[64] This would be the device for softening Ramsden's attitude to training Frenchmen. It was, admittedly, quite a step to buy an English instrument for the Paris observatory, but the long-term outcome made it worth the loss of face, and they would acquire a desperately needed modern instrument as well as a model for future imitation. Cassini left in September 1787 with permission to order a 7-foot transit instrument and to negotiate the placing of French workers in London workshops. He would be a shopper with a very particular agenda, not least because he did not really approve of shopping.

Cassini was not disappointed in Ramsden; indeed he was enormously impressed: "I recognised that despite all our efforts we would never have so consummate an artist in France; all rivalry, all comparison seemed now to me impossible faced with such a great talent."[65] Ramsden was full of ideas and conversation. The kinds of shop discussions we have noted, engaging other makers and other visitors, had become in Ramsden's case an inspirational audience for Cassini.

> Leaving one day from one of these conversations in which I loved to take part and be instructed by him, I said to a stranger, who was just as enthusiastic as I about the merit of M. Ramsden: In truth, this man is an electrical machine which you only have to touch to draw a spark. Your comparison could not be more appropriate, was the stranger's animated reply, for you could very well get nothing more than sparks here.[66]

Elsewhere the electrical machine was a star attraction in the polite entertainment offered in the shops of instrument makers; here it was a metaphor for the extraordinary maker himself. Whether at this stage Cassini appreciated the meaning of the foreigner's response is not clear, but sparks were all he could hope to draw from this machine: he would never acquire an instrument from Ramsden.

Ramsden was utterly charming and plausible. Cassini spent close to two years in London, and he visited the shop "ceaselessly." Ramsden spent a great deal of time with him, showing him instruments, promising him everything, and delivering nothing. Cassini attributed this to Ramsden's

perfectionism and his fascination for new and improved designs: "Don't think that it is indifference or laziness on his part: quite the contrary. But a new idea, a difficulty to overcome or an instrument of some new type that someone proposes to him will attract all his attention and make him abandon any work he has started."[67] In this context a transit instrument, one stipulated to be modeled on the one already made for Palermo, would not excite much interest for Ramsden. Whether or not he was flattered to receive an order from the *Observatoire*, it did not represent the most exciting work he had in hand. In fact the discussions resulted in two instruments being ordered—the transit instrument and a rotatable wall with an 8-foot quadrant on one side and a complete circle on the other. The virtues of the circle over the quadrant were beginning to exercise Ramsden's interest and inform his later designs, something Cassini must have picked up from their many conversations. The instrument would permit a comparison between the circle and the quadrant, he wrote to Ramsden on his return, confirming the order: "I believe this deserves to excite your genius."[68]

Despite all Cassini's efforts to obtain his instruments, and despite Ramsden's continuing promises, only the transit instrument was completed, and it was made by Matthew Berge, Ramsden's foreman and successor in business. It was delivered in 1804, eleven years after Cassini's return and four years after Ramsden's death. Meanwhile Cassini's greater projects had been overtaken by the disruption of the Revolution. In truth Ramsden did not need Cassini's commission. He had told him in replying to his written order that he had forty or fifty men employed in his workshop. The regular business provided income for the extraordinary, but this meant that Ramsden was free to choose the extraordinary on his own terms. Cassini could have noticed this danger when he read Ramsden's reassurance that he did not need to worry about financing the work: "The regular business of my workshop provides me with the necessary income. My main objective is the perfection of instruments. This part of our profession is still in its infancy."[69]

Cassini offers more analysis than other visitors, but the general pattern of their experiences has become familiar and to some extent repetitive. It is time to stop adding examples and attempt some analysis of our own. It is evident to our shoppers that makers in London are much more engaged in entrepreneurial commerce than those in Paris; this leads both to a greater visibility, and to a more flourishing manufacturing enterprise largely invisible to visitors. In the way things are managed in London, the growth of demand for routine items enables innovation and design development for more individual and special pieces. The more successful makers are less dependent on the dictates of clients for these more ambitious designs, and in extreme cases their success and reputation were such that they could afford to ignore commissions that were not to their taste—not because they were

difficult or costly to undertake, but because their design ambitions lay elsewhere. The astronomer Francis Wollaston failed to interest either Ramsden or Troughton in his proposal for an instrument and was obliged to take his custom to the less able and less prestigious maker William Cary, complaining that, "observers know best what they want; and an instrument-maker who will condescend to listen to them is a treasure."[70]

We have seen that the existence of a shop space was a valuable resource in the makers' situation. They were, after all, presented with some problems. On the one hand, they were trading in mathematics and natural philosophy—their material products were supposed ultimately to deliver more than materiality to their customers—so they needed to present a "polite" image to the world. But at the same time they ran mechanical workshops, and the skill and reliability of those who worked there was of legitimate concern to customers. A shop—an intermediate space between the street and the workshop—could be used in imaginative ways to negotiate the distance between the polite and the mechanical. The shop was a place to which visitors had unannounced access, and to that extent it was part of the public realm, but the maker controlled this space and what took place there. He could make himself and his special instruments available there in different ways, according to the importance and the purchasing potential of the customer.

As we have seen from our shoppers in London, the ways in which this access was managed included repeat visits, discussions, demonstrations, lectures, experiments, and even mechanical instruction, as well as traditional shop displays. The shop could to some extent be held ready for casual demonstration and explanation, or could be made ready for a special session arranged by appointment. Its relationship with the workshop meant that such sessions could be scheduled in sequence with workshop output. Anita McConnell's study of the London workshops cites examples of recorded premises that included a shop, a workshop, living quarters, and the possibility of other workshops nearby. These resources were augmented by links to more widespread workshops under different direction through the network of subcontracting.[71] The control the maker or retailer exercised over the shop space meant that his response could be tailored to the shopper, though in the case of the most prestigious and independent makers, this could spell frustration even for distinguished callers. Hornsby records several frustrating visits to Ramsden's premises to complain about delays, when he was kept waiting in the shop without seeing the great man, even though he was convinced that Ramsden was in a back room.[72]

This chapter has been mainly concerned with commerce; what can it say about the representation of nature? First, it is clear that there is a link between activities in the shop and those taking place at other locations in the geography of contemporary natural philosophy, including the Royal Society.

We are inclined to think of the commercial manifestation as an opportunist outgrowth from the academy—Hauksbee finding a business opportunity in the model of illustrative demonstration developed by Hooke. But while that may still be the dominant direction of influence, we need to be cautious in simply assuming that this is the whole story, not least because the chronology is not clear-cut, as we have seen through the cases of Reeve, and even earlier of Allen. Monconys could listen to the Royal Society debates about the "glass teardrops" and, had he lived, could have read about them in Hooke's *Micrographia*, but he could also buy them by the score in the shops of instrument makers. Whatever may be concluded about directionality from a more detailed study, it is clear that similar kinds of things were taking place across a range of locations, some under a stronger commercial agenda, others prioritizing natural philosophy, but for contemporary observers some morphological similarity would have been obvious. At the very least, it was the shops that disseminated a form of natural philosophical practice to a broad public; is was therefore appropriate that the popular textbooks of the eighteenth century arose largely from these commercial enterprises.

One important difference between the situations of makers in London and Paris was the guild or company regulation that applied in the two cities. In Paris, companies regulated particular trades, seeking to control the size of workshops, the provision of labor, the methods of production, and the choice of material.[73] Further, these regulations became stricter and more stringently enforced in the eighteenth century. Various companies sought to control instrument making, as a relatively new trade, but it was not clear which was most appropriate, and disputes arose that disrupted production, with makers even having tools and materials seized. As instruments were developing in the period, makers in fact needed to use a variety of skills and materials, and they did not fit into a particular category. One way of avoiding these difficulties was to achieve royal protection and work in the *Galeries du Louvre*—a further step away from the kind of brash commercialism evident in London.

The guild situation in London was very different. Here a maker needed to belong to some company or other in order to trade in the city, but it did not matter which he joined and he was not bound by any regulations governing his product. Once a successful maker belonged to a company, his apprentices would be made free of that company after completing their apprenticeship, so that dynasties of successive generations of master and apprentice would become established in the Grocers, Stationers, Merchant Taylors, or whatever.

If we consider the makers we have come across in this study, Allen was a Grocer and Clockmaker, Greatorex a Clockmaker, Thompson a Stationer, Culpeper and Adams were Grocers, Rowley a Broderer (embroiderer), Mar-

shall a Turner, Patrick a Joiner, Moxon a Weaver and Stationer, Martin a Goldsmith, and Smith, Pyefinch, Nairne, and Watkins were Spectaclemakers. Many other seemingly unlikely trade affiliations were represented throughout the instrument makers. With the exception of the Spectaclemakers, the instrument makers did not, of course, practice any of these trades, but they did belong to the companies and assumed such obligations as holding office.[74]

Instrument historians have been unsure what to do with this information, apart from being amused at the idea of makers being classified as grocers, dyers, fishmongers, haberdashers, and so on, and using the surviving guild records as a powerful tool for dating makers and their signed instruments. However, the involvement of the makers in a variety of companies will have brought them into contact with a range of trading practices and given them a familiarity with the general commercial life of London.

One very important development in London, which is particularly evident at the beginning of the eighteenth century, is trading across the traditional distinction between mathematical and optical instruments. Mathematical instruments were made by specialist engravers, while the relative newcomers were the optical instrument makers, who had emerged from among the most skilled makers of spectacles. In addition to these two categories, there were now also instruments of natural philosophy, derived from the new enthusiasm for experiment. There is no *prima facie* reason why these three types of instrument should be retailed together and why they should eventually be accommodated by a single category, "scientific instrument"—that it seems natural to us is simply our inheritance from a conjunction formed in the eighteenth century—but the possibility was created by company regulation in London, where there were no restrictions on what company a maker might join or what he might make or sell.

Two of the makers we have encountered are particularly associated with early trading across the mathematical / optical distinction, namely Culpeper and Rowley, but it soon became widespread, and with the addition of experimental instruments of natural philosophy, it was characteristic of the operations of many makers, among whom Adams and Martin were prominent. By this account there is indeed a link between commerce and the representation of nature: the very formation of the category of scientific instrument owed something to the regulation of trading in London, while the makers' acumen in encouraging the extraordinary growth of consumer interest in natural philosophy may well be related to their association with colleagues in companies dealing with luxury consumer goods, such as the Broderers or the Merchant Taylors.

A few makers managed to trade without joining companies, especially those associated with the Royal Society, either as fellows or through their

close connections with senior astronomers and observatory commissions. Among those we have mentioned, this would apply to the Sissons, Bird, Short, and Ramsden. We have seen that there were links between experimental demonstration as presented at the society and as organized in the shops of makers. Might there be another relationship with the commercial world? Might the Royal Society have acted in some respects in the role of a company, by making it possible for some makers to operate outside the usual obligations to the city? It might be said that this simply reflects the declining power of the London companies, but makers could scarcely have begun to flout their authority without some alternative form of support and patronage.

This was not a formal responsibility of the Royal Society, but by virtue of its royal charter it had the status, rights, and privileges of a chartered corporation. George Graham, a Royal Society Fellow, who established the role of the elite, specialist maker of astronomical instruments in London, was the first to employ assistants in the instrument-making side of his business without binding them as apprentices. This was how Sisson and Bird entered the trade, and they never joined a company. (Graham was a Clockmaker, having served an apprenticeship under Thomas Tompion, and took apprentices in the company for that side of his activities.) Lalande noted the status enjoyed by makers such as Sisson and Bird within the circles of the Royal Society and among the important astronomers—a *de facto* if not *de jure* measure of protection, which allowed them to avoid the attentions of the regular companies. Short was introduced to the London mathematicians through his patron in Edinburgh, Colin Maclaurin, and was a fellow before he moved permanently to London. Ramsden entered the trade through his employment by Jeremiah Sisson, and he became a fellow in his own right; his best-known employees, Matthew Berge, John Stancliffe, and Thomas Jones (a fellow), had no company affiliations.

Thus the entanglement between the Royal Society and the commercial life of the instrument makers had at least two aspects: the makers' shops had some of the functions we associate with the society in relation to natural knowledge, and the society in effect had some of the functions of a livery company.

EPILOGUE: BUGGE IN PARIS

By the time Thomas Bugge visited France at the end of the eighteenth century, the old guild structure and its regulatory apparatus had been swept away by the Revolution.[75] Already there are clear signs of a revival of the Paris workshops. Bugge's account has something of the flavor of Bernoulli's letters from London: there is plenty to say. Occasionally Bugge enters the

caveat that the work is not quite as good as in London, but in general he is very positive, and some of the work he sees is excellent.

Lenoir had a large workshop, which Bugge was able to visit, and he made a wide range of mathematical and astronomical instruments. The optical instrument maker Laroche had good reflecting telescopes and achromatic refractors, and he had lots of conversation. For the first time among the records of these visitors, we hear of a French maker engaging in extended discussions and demonstrations. Dumotiez made physical instruments, which Bugge bought and recommended; he did not only offer the standard designs, but would work from the customer's drawings. Fortin was very good, though expensive, while Betalli and Perrical were excellent glassworkers. Behind these individual stories, there were general signs of a consumer market, with between twelve and fourteen shops selling instruments near the *Pont Neuf* in the *Quai de l'Horloge* and several more in the *Palais Royal*.

In 1801 Lalande announced that the work of Lenoir had demonstrated that "the French industry is no longer behind the English." This was premature, but certainly a change was under way that would bring the two traditions into much more equal competition by the midcentury. Comparison between Paris and London is not so artificial a perspective for the historian as it may appear. It was present, implicitly or explicitly, in most of the accounts we have examined, and it occasionally surfaces in remarks made by the makers themselves. As an old man, Lenoir designed a dividing engine—the machine for which the English makers, particularly Ramsden and Troughton, had been especially celebrated. It is not clear what he can have meant in technical terms, but the emotional significance of his remarks was clear when he explained, "I have not tried at all to imitate the English; on the contrary I dare to assert that my method is completely French."[76]

Notes

1. "Me voici à Londres depuis 8 jours; je ne puis vous parler encore d'Astronomes ni d'Observatoires; mais je vous serai part de la surprise agréable où est jetté un Astronome en parcourant les rues de cette Capitale. Vous avés sûrement oui parler de la richesse & de l'éclat des boutiques de Londres, mais je doute que vous vous représentiés combien l'Astronomie contribue à la beauté du spectacle: Londres a un grand nombre d'Opticiens; les Magasins de ces artistes sont remplis de Télescopes, de Lunettes, d'Octans &c. Tous ces instrumens, rangés & tenus proprement, flattent l'oeil autant qu'ils imposent par les réflexions auxquelles ils donnent lieu." J. Bernoulli, *Lettres astronomiques* (Berlin, 1771), 63.

2. "Vous connoissés très bien le nom de M. DOLLOND; l'Artiste célebre" Bernoulli, *Lettres*, 65.

3. For foreign accounts of London instrument makers, see G. L'E. Turner, "The London Trade in Scientific Instrument Making in the Eighteenth Century," *Vistas in Astronomy* 20 (1976): 173–182.

4. Balthazar de Monconys, *Journal des voyages de Monsieur de Monconys* (Lyons, 1665–66).

5. "vne feüille de verre sur laquelle ces obiects sont peints," Monconys, *Journal*, 17–18.

6. "ie le trouuay dans son élement, enfoncé dans le commerce des Physiciens, & ne respirant que machines, & que nouelles experiences." Samuel Sorbière, *Relation d'un voyage en Angleterre* (Paris, 1664), 66.

7. Henry Oldenburg, *The Correspondence of Henry Oldenburg*, ed. A. Rupert Hall and Marie Boas Hall, 9 vols. (Madison: University of Wisconsin Press, 1965–73), 2: 285–291.

8. Ibid., Vol. 2: 271.

9. A. D. C. Simpson, "Richard Reeve—the English Campani—and the Origins of the London Telescope-Making Tradition," *Vistas in Astronomy*, 28 (1985), 357–365. For more detail on Reeve, see A.D.C. Simpson, "Robert Hooke and Practical Optics: Technical Support at a Scientific Frontier," in *Robert Hooke: New Studies*, ed. Michael Hunter and Simon Schaffer (Woodbridge: Boydell Press, 1989), 33–61. The much earlier shop of Elias Allen, in the 1620s, seems to have been a place of resort for practical mathematicians, a source of news and a means of communication. See William Oughtred, *The Circles of Proportion* (London, 1633); Hester Higton, *Elias Allen and the Role of Instruments in Shaping the Mathematical Culture of Seventeenth-Century England*, Ph.D. dissertation, University of Cambridge, 1995.

10. E. G. R. Taylor, *The Mathematical Practitioners of Tudor and Stuart England* (Cambridge: Cambridge University Press, 1970), 220–221.

11. Zacharias Conrad von Uffenbach, *London in 1710 from the Travels of Zacharias Conrad von Uffenbach*, ed. W. H. Quarrell and Margaret Mare (London: Faber & Faber, 1934).

12. Ibid., 158.

13. Ibid., 146.

14. Gloria Clifton, *British Scientific Instrument Makers 1550–1851* (London: Zwemmer, 1995), 194.

15. Uffenbach, *London*, 77.

16. Ibid., 145.

17. Ibid., 173.

18. Ibid., 77.

19. Ibid., 168. For the received early history of the reflector, see Henry C. King, *The History of the Telescope* (New York: Dover, 1979), 67–92.

20. Uffenbach, *London*, 168.

21. A. Q. Morton and J. A. Wess, *Public and Private Science: The King George III Collection* (Oxford: Oxford University Press, 1993), 39–65.

22. Ibid., 77–78.

23. Ibid., 168–170.

24. M. Lister, *A Journey to Paris in the Year 1698* (London, 1699), 80.

25. Maurice Daumas, *Les instruments scientifiques aux XVIIe et XVIIIe siècles* (Paris: Presses Universitaires de France, 1953), 97–113, 339–385.

26. J. Lalande, *Journal d'un Voyage en Angleterre 1763*, trans. Helene Monod-Cassidy (Oxford: Voltaire Foundation, 1980).

27. "Ce n'est que par tatonnement." Lalande, *Journal*, 25.

28. Lalande, *Journal*, 60.

29. Ibid., 33.

30. Ibid., 32–3.

31. Ibid., 38, 42, 47.

32. J. A. Bennett, "The English Quadrant in Europe: Instruments and the Growth of Consensus in Practical Astronomy," *Journal for the History of Astronomy* 23 (1992): 1–14.

33. J. Bird, *The Method of Dividing Astronomical Instruments* (London, 1767); J. Bird, *The Method of Constructing Mural Quadrants* (London, 1768).

34. Lalande, *Journal*, 72.

35. Bernoulli, *Lettres*, 72–74.

36. "fait des cours de phis[ique] ridiculement," Lalande, *Journal*, 44.

37. Bernoulli, *Lettres*, 70, 74, 96.

38. Ibid., 126–132.

39. Ibid., 68–69.

40. Ibid., 65–66.

41. Ibid., 138–173.

42. Thomas Bugge, *Journal of a Voyage through Holland and England, 1777*, ed. K. Møller Pedersen (Aarhus: Department of History of Science, 1997).

43. Ibid., 128–131.

44. Ibid., 154–155.

45. Ibid., 128–129.

46. Ibid., 130–133.

47. Ibid., 130–133.

48. Ibid., 140–145.

49. Ibid., 162–171.

50. Ibid., 296–301.

51. Ibid., 156–161, 170–177.

52. Ibid., 178–185, 191.

53. Ibid., 184–189.

54. Ibid., 254–255.

55. Ibid., 344–345.

56. Ibid., 198–208.

57. Martinus Van Marum, *Martin Van Marum. Life and Work*, ed. R. J. Forbes, 6 vols. (Haarlem: H. D. Tjeenk & Zoon, 1969–76), Vol. 2: 220–239.

58. Maurice Daumas, *Scientific Instruments of the Seventeenth and Eighteenth Centuries and Their Makers*, trans. M. Holbrook (London: Batsford, 1972), 148, 330.

59. Van Marum, *Life and Work*, 2: 266–272.

60. Ibid., 2: 270–272.

61. "L'Observatoire avait été muni alors de muraux, de grands quarts de cercles mobiles, ouvrages des Langlois, des Canivet, des Lennel, qui étaient en ces tems-là les plus célèbres constructeurs d'instrumens d'astronomie. Mais au moment où je pris la direction de l'Observatoire, ces vieux talens étaient éclipsés par les Bird et les Ramsden, artistes anglais qui avaient porté leur art à la plus haute perfection, laissant bien loin derrière eux les Français, à qui ils avaient enlevé presqu'entièrement le commerce des instrumens d'optique et de mathématiques." J. D. Cassini, *Mémoires pour servir a l'histoire des sciences et a celle de l'observatoire royal de Paris* (Paris, 1810), 4.

62. "Combien de fois je me suis indigné contre des personnes qui, me priant de leur procurer un bon instrument, le marchandaient comme une aune de drap! Quel prix coûtera-t-il? me demandait-on; pas aussi cher, sans doubte, qu'un instrument anglais? Pourquoi non? répondais-je; voulez-vous être juste? si l'instrument ne vaut rien, ne le prenez pas: mais s'il est bon, payez-le ce que l'ouvrier demandera, vous le fît-il même acheter plus cher que s'il était anglais." Cassini, *Mémoires*, 5.

63. "j'irai voir ces superbes instrumens anglais, examiner ces chef-d'oeuvres de l'art, et ces modèles que notre première ambition est d'imiter en France. .J'aurai occasion de voir et de cultiver les Dollond, les Stroughton [Troughton], les Ramsden." Cassini, *Mémoires*, 20.

64. "sans doubte il sera flatté de travailler pour l'Observatoire royal de Paris, où il n'y a encore aucun de ses ouvrages." Cassini, *Mémoires*, 20.

65. "je reconnus que malgré tous nos efforts nous n'aurions jamais en France un artiste aussi consommé; toute rivalité, toute comparaison me parurent désormais impossibles vis-à-vis d'un si grand talent." Cassini, *Mémoires*, 23.

66. "Sortant un jour d'un de ces entretiens où j'aimais tant à m'engager avec lui et à m'instruire, je dis à un étranger non moins enthousiasmé que moi du mérite de M. Ramsden: En vérité, cet homme est une machine électrique qu'il suffit de toucher pour en tirer une étincelle. Rien de plus juste que votre comparaison, reprit vivement l'étranger, car vous pourriez fort bien ici ne tirer que des étincelles." Cassini, *Mémoires*, 23.

67. "Ne croyez pas que ce soit indifférence ou paresse de sa part: bien au contraire. Mais une idée nouvelle, une difficulté à vaincre ou un instrument d'un nouveau genre qu'on viendra lui proposer vont attirer toute son attention et lui faire abandonner tout ouvrage commencé." Cassini, *Mémoires*, 24.

68. "je la crois digne d'aiguillonner votre génie." Cassini, *Mémoires*, 28.

69. "Le courant de mon atelier me fournit suffisamment l'argent nécessaire. Mon principal objet en vue, c'est la perfection des instrumens. Cette partie de notre profession est encore dans son enfance." Cassini, *Mémoires*, 179.

70. See D. W. Dewhirst, "Meridian Astronomy in the Private and University Observatories of the United Kingdom: Rise and Fall," *Vistas in Astronomy* 28 (1985): 147–158.

71. Anita McConnell, "From Craft Workshop to Big Business—The London Scientific Instrument Trade's Response to Increasing Demand, 1750–1820," *London Journal*, 19 (1994): 36–53.

72. J. A. Bennett, "Equipping the Radcliffe Observatory: Thomas Hornsby and his Instrument-Makers," in *Making Instruments Count: Essays on Historical Scientific Instruments Presented to Gerard L'Estrange Turner*, ed. R. G. W. Anderson, J. A. Bennett and W.F. Ryan (Aldershot: Variorum, 1993), 232–241.

73. Anthony Turner, "Mathematical Instrument-Making in Early Modern Paris," in *Luxury Trades and Consumerism in Ancien Régime Paris*, ed. Robert Fox and Anthony Turner (Aldershot, 1998), 63–96.

74. For the makers and the London guild companies, see Joyce Brown, *Mathematical Instrument-Makers in the Grocers' Company 1688–1800* (London: Science Museum, 1979); M. A. Crawforth, "Instrument Makers in the London Guilds," *Annals of Science*, 44 (1987): 319–377; Clifton, *Directory*.

75. Thomas Bugge, *Science in France in the Revolutionary Era. Described by Thomas Bugge*, ed. M. P. Crosland (Cambridge, Mass.: Society for the History of Technology, 1969).

76. "l'industrie française ne le cède plus à celle des Anglais"; "je n'ai point cherché à imiter les Anglais; j'ose au contraire avancer que ma méthode est toute française"; Daumas, *Les instruments scientifiques*, 365.

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EPILOGUES

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A World of Wonders, A World of One

LISSA ROBERTS

When nature is reborn in us, it calls itself art.
—Max Weber, American painter

When Copernicus placed the sun at the center of the cosmos, he was driven by an aesthetic compulsion. The efforts of other astronomers, as he told it, were "just like someone taking from various places hands, feet, a head, and other pieces, very well depicted, it may be, but not for the representation of a single person; since these fragments would not belong to one another at all, *a monster rather than a man* would be put together from them." If the world was indeed "created for our sake by the *best and most systematic Artisan of all*," as Copernicus believed, it was bound to exhibit "symmetry of its parts."[1] The task and burden of the philosophical astronomer was to uncover the cosmic order manifested in its unified arrangement. Copernicus struggled to do just this, breathing his last as *De Revolutionibus* was being printed in 1543.

This tragically heroic tale is the starting point for many renditions of the "Scientific Revolution," though authors tend not to dwell on the aesthetic dimension of its history. It is not my plan here to rehearse the generally told story of the Scientific Revolution or even to refute it. I want instead to introduce a cluster of issues that sit within the above snippet of Copernicus's text and find resonance in this collection of essays. By doing so, I hope to get at a tension that exists in our understanding of the history of early modern European art and science, one that needs to be resolved if we are to achieve the kind of historical synthesis that this book aspires to stimulate. At the risk of anticipating what I set out below, this tension can be understood briefly as existing on two related levels. Historiographically, an explanatory cleft lies between the history of the mathematical sciences, on the one hand,

and of the descriptive and experimental sciences on the other. A tandem divide separates historians who discuss the arts and sciences of early modern Europe as having been undergirded by the aesthetic principles of unity and order from those who emphasize the aesthetic principles of variety and uniqueness. Once I spell this tension out more fully, I want to indicate what I see as the potential of this book's collective vision for resolving it. And finally, I want to argue that the tension between the principles of unity and variety was already recognized and debated during the early modern period itself. What ultimately served to resolve it historically was a focus on activity, both in terms of philosophical reflection and in terms of everyday life, as increasingly dominant market activities came to shape the production of goods and ideas in a way that reflective philosophy never had the power to do on its own. This book's focus on practice, then, couldn't be more fitting.

THE ESSENTIAL TENSION?

> A man cannot tell whether Apelles, or Albrecht Dürer, were more trifler; whereof the one would make a personage by geometrical proportions; the other, by taking the best parts out of divers faces to make one excellent.
>
> —Francis Bacon, "On Beauty"

I begin with Copernicus's carefully chosen analogy between the astronomer's depiction of the cosmos and the anatomist's depiction of the human microcosm. Without speaking of influence, it is certainly striking that Andreas Vesalius's *De Humani Corporis Fabrica* was published in the same year as *De Revolutionibus*. A fellow Paduan (Copernicus had attended the University of Padua prior to Vesalius's arrival), Vesalius too presented an anatomized image of the body—human microcosm rather than cosmic macrocosm – that exhibited the ordered symmetry of its parts. Indeed, whether associated with Plato, Vitruvius, Horace, or any other ancient antecedent, the ideal of nature as an harmonious, unified whole that was constructed from a divinely (quasi-)mathematical blueprint was a recurrent trope during the Renaissance.[2] Not only did this feed new representations of the world, its parts, and inhabitants (and methods for investigating them), it inspired various artists and architects to adopt new principles of perspective as a foundation for their work as well.

That these were more than coincidental developments among a range of natural philosophical and artistic endeavors is attested to by repeated claims that reverberate across apparent divides. Architects drew inspiration for their designs from contemporary depictions of the human body ("nowhere

else than that sacred temple made in the image and likeness of God, which is man—in whose make up all the other wonders of nature are comprised"),[3] while descriptions of the human body as a divinely constructed "temple" echoed Copernicus' (and others') explicit description of the cosmos.[4] From microcosm to macrocosm, from nature to products of human design, the guiding watchwords were (divinely rooted) unity and order.

Historians have argued that this perspective was crucial for the subsequent development of a unitary natural philosophy that sought to portray the universe as a system with a structure and motions that were bound by divinely ordained mathematical laws.[5] At the heart of what is traditionally presented as the Scientific Revolution stood the urge to read the divinely authored "book of nature" which, for men such as Galileo, was written in the language of mathematics. Because nature was created and maintained by unitary laws, according to this perspective, it must be possible to uncover them by examining natural phenomena in terms of the measured and measurable patterns they exhibited. Whether this was done through experimentally based induction, the application of mechanical analogy or mathematical analysis, the goal was the same—to reveal the order and unity of nature.[6]

If combined historical and historiographical scrutiny has taught us anything, it is that there are other ways to tell this story. In his classic study of European art history, for example, Arnold Hauser referred the Renaissance urge toward unity to a "spirit" very different from Neoplatonism.

> The principles of unity which now become authoritative in art . . . express the same dislike for the incalculable and the uncontrollable as the economy of the same period with its emphasis on planning, expediency, and calculability; they are creations of the same spirit which makes its way in the organization of labour, in trading methods, the credit system and double-entry bookkeeping, in methods of government, in diplomacy and warfare. The whole development of art becomes part of the total process of rationalization. . . . The things that are now felt as "beautiful" are the logical conformity of the individual parts of a whole, the arithmetically definable harmony of the relationships and the calculable rhythm of a composition . . . and the mutual relations of the various parts of the space itself.[7]

Hauser's narrative fits perfectly with the minority voice of Marxist historians of science (and their fellow travelers) mentioned by Paula Findlen and Pamela Smith in this book's introduction, who sought to root the development of modern science in the rise of capitalism. According to this version of history, it was the materially grounded march of economic development that both brought unity to a range of human endeavors and posited unity as the philosophical expression of an historic process of rationalization.

It is important to note that, while I began with a saga of intellectual struggle and then countered it with one built on the dialectic of material conditions, both these accounts privilege the linked aesthetic principles of unity and order. They portray this aesthetic as prescribing method, determining boundaries between science and craft, and giving shape to both scientific and artistic production. Strikingly, the essays in this volume imply a rather different tale of the relations between art and the study of nature. While it also comes in two (though expressly not autonomous) versions—we might call one a "history of representing" and the other a "history of intervening"—what brings both these versions together, by and large, are the inverse aesthetic principles of variety and uniqueness.[8] According to the authors in this volume, what seems to have marked and demarcated both nature and its investigation on one side, and artistic production and appreciation on the other, were the thirst for and apprehension of uniqueness and wonder.[9] Ironically, while historians' focus on the aesthetics of unity has led to an image in which a boundary separates the arts and sciences, the present focus on variety paints a picture of continuity between them.

SCIENCE: A MATRIX OF MARVELS

> . . . a marvelous museum . . . a small theater in which all the wonders of nature can be displayed in miniature.
>
> —Giralmo Porro's description of Padua's botanic garden, 1591

As was the case with so many beliefs, Aristotle's authority helped legitimate the traditional opposition between art and nature.[10] In contrast to this tradition that fostered a fascinating history of art's competition with natural beauty and wonder, the dictum that "beauty is truth" became a highly respectable one by the beginning of the eighteenth century, especially as formulated in the third Earl of Shaftesbury's aesthetics.[11] Even before his articulation of this view, however, many of the actors presented in this book accepted and modified the equation by defining beauty in terms of the individuating aesthetic principles of variety and uniqueness. Hence, the construction and increase of knowledge required, first, the collection of extensive stores of singular phenomena. On one hand, this connects with discussions of how these *naturalia*, *artificialia*, scientific instruments, and models (the general categories of items that stocked these collections) were identified, produced, and distributed, to which we will return. On the other hand, it leads to the question of how the increasing range of phenomena were stored, categorized, represented, and used.

The most obvious collection sites were gardens and cabinets where aristocrats, merchants and corporations (be they cities, universities or amateur societies) alike amassed and displayed their holdings. To these Claudia Swan adds mimetic illustrations and grids: representational collections in which illustrated (either pictorially or verbally) elements were laid out in a way that at least partially corresponded to their physical position in space and time. The reference to Foucault is blatant.

> The Classical age gives history a quite different meaning: that of undertaking a meticulous examination of things themselves for the first time, and then of transcribing what it has gathered in smooth, neutralized, and faithful words. . . . The documents of this new history are not other words, texts or records, but unencumbered spaces in which things are juxtaposed: herbariums, collections, gardens; the locus of this history is a non-temporal rectangle in which, stripped of all commentary, or all enveloping language, creatures present themselves one beside another, their surfaces visible, grouped according to their common features, and thus already virtually analyzed, and bearers of nothing but their own individual names.[12]

If the analogy between material sites and their representations seems only partial—painters, for example, were free to portray bouquets of blooming flowers that, in fact, blossomed at different times—the difference was actually only a matter of degree. For what all these venues had in common was that they formed an intersection of art and the objects of nature that endeavored to escape the strictures of natural time and space, and it was out of that juncture that knowledge (not to mention value) was produced.

Since the Renaissance, gardens were spoken of as embodying a "third nature"—a world borne of the marriage between the creative forces of primal nature and human artifice, dedicated simultaneously to utility and pleasure, built to grow plants out of both their native spaces and times.[13] And, as a number of essays in this collection remind us, the *Wunderkammern* of Europe were also filled with a range of items—some found in nature, others embellished or created out of whole cloth by artists, artisans, and instrument makers—drawn from around the world and across the scope of the human imagination. If gardens were experimental sites for transplanting exotics, creating new varieties and advancing "physick" through the cultivation of medicinal plants (not to mention the architectural fancies they housed), cabinets held collections that also stimulated work as well as wonder. They fed the intellectually productive fires of anatomy, natural history, and metallurgy, while stoking the skills of specimen production and preservation, of artisanal precision and presentation. Opening their doors opened the world in miniature, rearranging the matrix

of space and time for the benefit of human understanding, consumption, and manipulation.

Representations of nature—be they in the form of still life paintings, anatomy sheets whose flaps could be raised to reveal bodily organs, natural histories or maps—helped to standardize portrayals of natural phenomena by adopting a naturalist style that made them, in all their uniqueness, amenable to surface comparison and categorization.[14] They also made them transportable, extending the potential for their interpretive consumption and exploitation. By domesticating the exotic and refusing to be bound by the ordering strictures of natural space and time, these representations afforded their viewers the opportunity to travel on their own terms—in the comfort of their homes and at a pace set by their leisure—through worlds laid out for their perusal and profit.

BEYOND THE GREAT DIVIDE: TOWARD A HISTORY OF DOING

> Let physicians and confectioners and the servants of the great houses be judged by what they have done.
>
> —Isak Dineson, "The Dreamers"

Before turning to the question of how the contents of these collections came to be there, I want to address another important set of contrasts between the sagas with which I began and those bound in this volume. In addition to revolving around mirror-image aesthetic principles—unity and order, on the one hand, variety and uniqueness on the other—they also appeal to different forms of natural knowledge and art. The first privileges the mathematical sciences—astronomy and physics—and unified perspective. The second focuses largely on natural history, alchemy, and medicine, along with representational description and handcrafted objects. Are we flirting here with a coupling of traditional oppositions: mathematical versus experimental sciences together with "Italianate" versus "Netherlandish" representation?

Traditionally, such a coupling worked at the expense of the "experimental sciences" and northern art. Consider Thomas Kuhn's claims, as referred to in this volume's introduction, that tied Baconians to commercial interests and thereby cut them off from the Scientific Revolution. Consider too Hauser's condescending appraisal. He writes that rationalism, the burgeoning hallmark of the Italian Renaissance, "does not remain restricted to Italian art; but in the North it assumes more trivial characteristics than in Italy, it becomes more obvious, more naive."[15]

The art historian Svetlana Alpers embraces these coupled dichotomies, but with a different strategy in mind, that of championing what she considers the

descriptive nature of Dutch seventeenth-century art. Not interested in resolving these claimed distinctions, she focuses instead on presenting a more positive interpretation of experiment and description. Alpers explicitly posits a parallel between the Baconian project and Dutch painting, with its purported penchant for description and its "established alliance with those craftsmen—goldsmiths, weavers, glassblowers and geographers—whose products became the crafted objects in their representations." Bacon's world, Alpers tells us,

> is stilled, as in Dutch paintings, to be subjected to observation. Detailed descriptions, compiled almost without end and fitted into the table, displace time, since each observation is separate from the next. Indeed, despite its title Bacon's natural history displaces history. . . . It is, like the Dutch art with which we have linked it, description, not narrative.[16]

Interested to portray seventeenth-century art as essential to its contemporaries' understanding of the world, Alpers commends Bacon's dictum that "the nature of things betrays itself more readily under the vexations of art than in its natural freedom."[17]

Should we too leave these paired dichotomies unresolved, with or without debating their (hierarchical) relation? To do so, I fear, fails to answer the challenge of crafting an inclusive explanation for what has come to be called the Scientific Revolution. Given the current unpopularity of grand narratives, this is perhaps a good thing. It could well be that no overarching explanation exists—or needs constructing—for the concatenation of activities and ideas associated with the investigation and representation of nature in early modern Europe. On the other hand, this volume houses a pregnant suggestion that deserves to be fleshed out: that we replace a history of deeds by a history of doing. Once *homo faber* takes center stage, apparent oppositions begin to disappear.[18] It is unclear whether their disappearance is a simply a function of our redirected attention, but we will discover this only when such an active history is told in more detail.

Klaas van Berkel takes us a step along the way toward writing this kind of history, though he still couches the introduction to his essay in this volume in the binary terms of mathematical and experimental sciences. The major actor of his story, like so many early modern practitioners of science, did not respect the boundary that these two categories imply. Indeed, I doubt Meijer recognized the existence of such a boundary; he practiced astronomy, was a successful engineer, and published books that beautifully illustrated both his own inventions and experiments done before the Roman Accademia Fisico-matematica, of which he was a member.

While this broad range of activities is characteristic of many "scientific" practitioners in early modern Europe, whether obscure or as famous as

Galileo (consider also that Copernicus trained in both medicine and law, as well as learning to paint and translate) and deserves attention, I want to focus here on Meijer's work as an engineer. Then as now, (successful) engineering combined mathematical ability with experimental and entrepreneurial skills. Besides being honored in scientific academies across the continent, engineering was taught in courses housed (with varying degrees of official recognition) at major universities in the Netherlands during portions of the seventeenth and eighteenth century. No less a figure than Willem 's Gravesande (known generally, in caricatured fashion, for having brought Newtonian science to the Continent) taught "Dutch mathematics," as it was known, for a time at Leiden University.[19] Institutionally as well as intellectually, then, engineering existed precisely at the point denied by a historiography that categorically separates mathematical and experimental inquiries of nature, relegating it to a lesser status that bears the adjective "applied."

Chandra Mukerji's essay underlines the importance of engineering while setting it in a more blatant political context. What remains of interest throughout her essay is the depiction of knowledge as constituted by a network of specialized knowing and skills; a coordinated distribution that crossed any number of disciplinary, social, and political boundaries in order to understand nature and thereby harness it for human use. Perhaps this is the most fitting way to investigate a period during which the loci of learning, knowledge production, and application were multiplying. Focusing on activities and the networks required to accomplish them frees us from the constraints entailed in studies whose inquiries are organized in terms of either ideas or institutions.

One might respond by saying that this model is applicable only to instances involving the creation of what Cicero long ago termed a "second nature;" that is, a landscape engineered for human use.[20] Indeed, Mukerji pointedly speaks of representations of nature as tools that were expressly used to transform that which they represented. We might see the maps discussed by Alison Sandman in a similar light. Though the "network" in which they were placed housed contention over what constituted the proper representation of nature and how that representation ought to be used—for the pragmatic purpose of navigation or that of "objectively" mapping the world—and, therefore, manifested contours that could only be solidified once the controversy was ended, the final product was one that brought together the expertise of navigators, cosmographers, illustrators, and politicians in order to assert (and challenge) Spanish imperial claims that aspired to remake the entire globe.[21] We might, then, further see Benjamin Schmidt's discussion of exoticism as an inverse reflection of this process whereby the Dutch compensated for their loss of empire by informing and controlling the market for geographic representations.

But I think the true test for this approach—that is, a "history of doing"—is whether it can go beyond this level of application and resolve the claimed dichotomy of mathematics and experiment in general. This would be to argue that the application of any and all human activity to the world, whether mental or manual, includes an act of transformation that can therefore be investigated in essentially the same way. One would, in other words, have to cast mathematical physics and astronomy in the same explanatory mold as engineering and experimental manipulations of nature. And one would have to present a convincing argument that the mathematical representation of nature resulted from the same kinds of sociointellectual processes and transformed nature through its representation in a way that could further be impressed in networks of knowledge and power.

From the standpoint of intellectual history, this entails developing the claim that mathematics had evolved, by the seventeenth century, from the ancient Greek conception "as an inventory of (ideal) mathematical entities and their absolute properties" to a formal language of relations, capable of representing mathematical and nonmathematical relations alike and thereby capable of "accounting" for observable changes in nature in a powerfully general way. This need not be an idealist history, for we know that the institutional context of early modern European mathematics increasingly permitted application of a method drawn from one discipline to the subject matter of another discipline, something strictly forbidden in Aristotelian logic as leading to category mistakes.[22] It further involves that we take seriously (that is, consider as more than handy analogies) the connections between what came to be called the "mechanical philosophy" and the mechanisms—living or otherwise—that Descartes and his contemporaries experienced firsthand as well as the intimate links between Newton's alchemy and his conception of gravity as an active principle.[23] Finally, it involves writing a full-blown cultural history of the mathematical sciences; that is, a history that integratively situates them in the broader cultural context of their time and simultaneously shows their practice to have been constitutive of that culture.[24]

THE MARKET AS MEDIATOR BETWEEN UNITY AND THE UNIQUE

> If phenomena are not all linked one to another, there can be no philosophy.
>
> —Denis Diderot, *L'Interprétation de la nature*

If beauty and truth came to be seen as inseparable, Anne Goldgar's essay reminds us that, increasingly, so were beauty and profit. To quote her, "What is rare is beautiful, and what is beautiful is profitable." While gar-

dens, *Wunderkammern* and the like might therefore be regarded as repositories of intellectual capital, to borrow Mark Meadow's formulation, so too did they relate to the nexus of cold, hard cash. Financing by private brokers, trading companies, and empires made both "discovery" and control of the globe increasingly possible and plausible. But a full range of technologies was equally important and had, consequently, to be invented, "improved," and applied. These technologies varied from navigational techniques and tools, on one side, to means of destruction and preservation on the other; from technologies that named and represented to technologies that silenced and produced transparence; from technologies that eliminated surprise to those that encouraged awe.

The telos of this technological engagement with nature and its elements was consumption, whether it involved ingesting herbals, imbibing facts, or absorbing sights, sounds, and textures. But it was a consumption that was conspicuous in the important sense that it gave rise to further productivity, be it health, understanding, or enhancement of artistic and artisanal skills. Hence production and consumption fed off each other in a spiral that had more to do, this book argues, with the densely populated world of work and wonder than with some grandly conceived process of rationalization.

Should we then be surprised if these developments involved an emphasis on variety and uniqueness rather than unity and order, as implied by at least some of the essays of this book? Or need we draw the conclusion that, in the end, this was indeed the case? For if the market that supplied and benefited from the growing urge to know and show appealed to its customers with the promise of variety, so too did it see the rise of standardization. While this was perhaps most obvious in the marketing of instruments and mechanical models, whose operational success and popularity depended on the play between apparent uniqueness and calibrated standards, the same can certainly be said for printed matter, natural specimens, and handcrafted *artificialia*, all of whose value was determined with reference to standardizing categories and notions of quality.

That we can detect the presence of a productive tension between these aesthetic ideals is clearly more than the result of historians' retrospection. Some of the most stimulating philosophical debates of the early modern period rested on this contest of emphasis. Spinoza, for example, who spent his days grinding lenses in market-mad Amsterdam, spoke of God and the world in monist terms. Leibniz, neither stranger to alchemy, automata, or imperial collections, called this "the best of all possible worlds," by which he meant that God could not but create a universe filled with as many distinct entities as did not involve a contradiction. His views (and pretensions) led him to argue with Newtonians over the nature of God and God's relation to nature.[25] Is that relationship marked by divine omniscience or omnipotence? Do we know God through the unified order or the infinite wonders he creates?

For many, the challenge was to find a way to say both. But as the eighteenth century wore on, increasing numbers (though still relatively few) questioned the need to refer to God at all when investigating nature. Where the market led, philosophy followed. And while Adam Smith drew the "invisible hand" to bring order to a commercial world of competing individuals, Voltaire looked around him and stated with pessimistic resignation that this is indeed the best of all possible worlds.

Notes

Epigraph quoted in Martin Green, *New York: The Armory Show and the Paterson Strike Pageant* (New York: Collier Books, 1988), 249.

1. Quotations drawn from Copernicus, *On the Revolution of the Heavenly Spheres* (London: David & Charles, 1976), 25.

2. Robert Westman argues that Copernicus's appeal to unity was not so much an invocation of Neoplatonic ideals as it drew on the rhetoric of Horace, for which there was a high regard at that time. "If a painter were willing to join a horse's neck to a human head and spread on multicolored feathers, with different parts of the body brought in from anywhere and everywhere, so that what starts out above as a beautiful woman ends up horribly as a black fish, could you my friends, if you had been admitted to the spectacle, hold back your laughter? Believe me, dear Pisos, that very similar to such a painting would be a literary work in which meaningless images are fashioned, like the dreams of someone who is mentally ill, so that neither the foot nor the head can be attributed to a single form." Horace, *Ars Poetica*, lines 1–13, quoted in Robert S. Westman, "Proof, Poetics, and Patronage: Copernicus' Preface to *De Revolutionibus*," *Reappraisals of the Scientific Revolution*, ed. David C. Lindberg and Robert S. Westman, (Cambridge, Mass.: Cambridge University Press, 1990), 183. I thank Claudia Swan for also calling the link to Horace to my attention.

In a different vein, it is interesting to note that Thomas Laqueur goes so far as to argue that the unity of Renaissance portrayals of human anatomy entailed depicting the female body as a modification of the male — what he refers to as the "one-sex model." Thomas Laqueur, *Making Sex. Body and Gender from the Greeks to Freud* (Cambridge, Mass.: Harvard University Press, 1990), especially chapter 3.

3. This quotation is from Daniel Barbaro's (1567) edition of Vitruvius, cited by Jonathan Sawday, *The Body Emblazoned. Dissection and the Human Body in Renaissance Culture* (London: Routledge, 1996), 70.

4. According to Pierre Gassendi, Copernicus used the artistic skills he learned as an extension of his study of perspective to paint a self-portrait. "He [Copernicus] concerned himself with all parts of mathematics so that, at one time, he dwelt especially upon [the study of] perspective, and, at another time, he took the opportunity to learn more about the art of painting, until he became skillfully practiced; and, it may be reported, as well, that he painted himself excellently using a looking-glass. Whereupon, he began to seek advice about painting, for while contemplating travel, and above all to Italy, he resolved not only to sketch but also, insofar as he could, to represent exactly whatever he found worthy of observation." Quoted in Robert Westman, "Proof, Poetics and Patronage," 184. I chose to quote this excerpt not only as a indication of the close links between artistic composition and astronomy as discussed in my essay, but also to comment on how intriguing it is to note that Copernicus appar-

ently did not deem astronomical observation crucial to astronomy's reform (he reportedly made no more than twenty seven observations himself), but considered observation of his own surroundings to be crucial for artistic representation.

5. For the most eloquent, if complex, expression of this argument, see Amos Funkenstein, *Theology and the Scientific Imagination from the Middle Ages to the Seventeenth Century* (Princeton, N.J.: Princeton University Press, 1986).

6. While it is certainly true that Bacon did not advocate the mathematization of nature, he did nonetheless distinguish his inductive view from "empiricks" who sought nothing more than to uncover and put to use individual phenomena. See, for example, his *New Organon*, aphorism 99.

7. Arnold Hauser, *The Social History of Art* (New York: Vintage Books, 1951), Vol. 2, 15.

8. For the categories of "representing" and "intervening," see Ian Hacking, *Representing and Intervening. Introductory Topics in the Philosophy of Natural Science* (Cambridge: Cambridge University Press, 1983). Hacking uses these words as a way to activate discussions of rationalism and realism. I use them here to indicate, in an equally active way, histories of how knowledge was constructed through its representation and how that construction process was enabled through various means of intervening in nature, the workshop and the marketplace (not to mention the political realm).

9. See also Lorraine Daston and Katharine Park, *Wonders and the Order of Nature, 1150–1750* (New York: Zone Books, 1998), 15–16.

10. Aristotle, *Physics*, 2.1, 192b. 9–19.

11. J. V. Arregui, "La teologia de la belleza en Shaftesbury y Hutcheson," *Thémata* 13 (1995): 11–35; J. Stolniz, "From Shaftesbury to Kant: The Development of the Concept of Aesthetic Experience," *Journal of the History of Ideas* 48 (1987): 287–305.

12. Michel Foucault, *The Order of Things. An Archeology of the Human Sciences* (New York: Vintage Books, 1973), 131.

13. There is a growing literature on the history of gardens. See, for example, John Dixon Hunt, *Gardens and the Picturesque. Studies in the History of Landscape Architecture* (Cambridge: M.I.T. Press, 1994); Chandra Mukerji, *Territorial Ambitions and the Gardens of Versailles* (Cambridge: Cambridge University Press, 1997).

14. Here I equate naturalism with Foucault's notion of the "table." See footnote 15. For anatomy sheets, see Andrea Carlino, *Books of the Body: Anatomical Ritual and Renaissance Learning* (Chicago: University of Chicago Press, 1999). For the struggle to standardize maps, see Alison Sandman's essay in this book.

15. Arnold Hauser, *Social History*, Vol. 2, 16.

16. Svetlana Alpers, *The Art of Describing. Dutch Art in the Seventeenth Century* (Chicago: University of Chicago Press, 1983), quotations on 103 and 109.

17. Bacon, quoted in ibid., 103.

18. For a view of *homo faber*'s historical significance, see Hannah Arendt, *The Human Condition* (Chicago: University of Chicago Press, 1958).

19. P. J. van Winter, *Hoger beroepsonderwijs avant-la-lettre. Bemoeiingen met de vorming van landmeters en ingenieurs bij de Nederlandse universiteiten van de 17e en 18e eeuw* (Amsterdam: Noord-Hollandsche Uitgevers Maatschappij, 1988) (*Verhandelingen der Koninklijke Nederlandse Akademie van Wetenschappen, Afd. Letterkunde*, Nieuwe Reeks deel 137).

20. The term Cicero used was *alteram naturam*.

21. For the relation between controversy resolution and the validation of network contours in science, see Trevor Pinch, "Towards an Analysis of Scientific Observation: The Externality and Evidential Significance of Observation Reports in Physics," *Social Studies of Science* 14 (1985): 167–187.

22. Amos Funkenstein, *Theology and the Scientific Imagination*, 297–298. Funkenstein makes the general claim that a new ideal of knowledge emerged in the seventeenth century that equated knowing with doing, not only in the commonly accepted Baconian sense, but more universally as a mirror of God's active intelligence.

23. For the mechanical philosophy see, for example, Otto Mayr, *Authority, Liberty and Automatic Machinery in Early Modern Europe* (Baltimore: Johns Hopkins University Press, 1986). For Newton's conception of gravity as an active principle, see Betty Jo Tweeter Dobbs, *The Foundations of Newton's Alchemy, or the Hunting of the Greene Lyon* (Cambridge: Cambridge University Press, 1975).

24. Mario Biagioli's *Galileo Courtier* (Chicago: University of Chicago Press, 1993) is an important step in this direction but falls short of offering a cultural history of the mathematical content of Galileo's natural philosophy. Instead he couples a well done history of its cultural context with an internalist analysis of the mathematics itself.

On the needed symmetry of explanation—that is, the mutual constitution of science and society/culture—see Bruno Latour, *Nous n'avons jamais été modernes* (Paris: La Découvérte, 1991).

25. See, for example, *The Leibnitz-Clarke Correspondence* (London, 1717). For an interesting discussion of the debate, see Steven Shapin, "Of Gods and Kings: Natural Philosophy and Politics in the Leibniz - Clarke Debates," *Isis* 72 (1981): 187–215.

Questions of Representation

THOMAS DACOSTA KAUFMANN

This book proffers a lavish array. Like some of the subjects they treat, the essays collected here draw their materials from various parts of Europe and touch on many parts of the globe. Including discussions of a variety of disciplines, they offer an expanded view of early modern history, and at the same time enrich earlier interpretations, especially of the history of science and the history of art. Yet while they intrigue us with fascinating intellectual wares, these essays also invite us to consider further some of the larger questions that they raise. This epilogue responds to some of the selection's stimuli.[1]

Connections that may be established between individual essays and across sections of this book indicate the general direction of this collection. While not all the individual essays may be regarded as "interdisciplinary" in approach, as a whole they suggest some ways in which considerations of similar issues from multiple yet compatible points of view may mutually enhance each other. While Mark Meadow points to an agent who he believes played a key role in the establishment of early modern collections, the *Kunstkammer* (here called, resonating with the title of the book, the *Wunderkammer*), Paula Findlen discusses the trade in actual objects, the curiosities that went into what was called in English the "curiosity cabinet." While Chandra Mukerji points to the entrepreneurial interests that were involved in cartography and hence in canal construction, Benjamin Schmidt emphasizes that mapmaking itself was an important element in what he refers to as a marketing strategy.

Most obviously, all the essays presented here thus eschew approaches that may be called "internal" to the historiography of disciplines, which traced transformations, or saw developments arising from within the traditional concerns of their fields. Accordingly the trajectory of science was one that involved methods, theories, and the accumulation of knowledge.[2] Classic

histories of science—for example, that of A. C. Crombie[3]—were histories of scientific ideas; at most they may have intersected with the history of ideas, as did an important older work by E. A. Burtt.[4] In the history of art a comparable "internalist" tradition was the history of style, as exemplified by Heinrich Wölfflin, Alois Riegl, or other art historians associated with Vienna, another that of iconography, the study of subject matter in art, as in the work of Émile Mâle.[5] While it may seem that such approaches have long been outmoded, and this collection parallels other recent efforts that move firmly away from internal histories, it is worth recalling that the tradition has survived, and the tendencies it expresses certainly formed a powerful force at the time many of the contributors to this collection were being educated: so suggests the simultaneous appearance of important syntheses in the historiography of art and the history of science thirty years ago.[6]

Alternative approaches were, to be sure, long available. For example, some of the intellectual origins of essays found here on the importance of practical alchemy or on systems of representation may be traced back to the works of Aby Warburg, Fritz Saxl, and other scholars associated with the Warburg Institute on astrological and occult imagery, or to that of scholars such as Erwin Panofsky on systems of representation, including studies of perspective and proportion.[7] Books by scholars such as Martin Wackernagel or Hans Floerke suggest that social and even economic histories of art were not entirely lacking earlier, either.[8] Somewhat similarly, so witness the works of Robert K. Merton and the influential study of Herbert Butterfield, cultural and social historical approaches to the history of science also existed in the earlier twentieth century.[9] Nevertheless, if a self-conscious social or economic history of art or science was practiced, it was most often to be associated with a Marxist tradition, not just in parts of Europe dominated by the Soviet Union, but in the West, both in the history of art, as exemplified by Frederick Antal and Arnold Hauser, and also in the history of science, as exemplified by J. D. Bernal.[10]

At the same time, however, and almost in the same year that older sorts of syntheses were produced—the early 1970s—newer tendencies were astir in art history.[11] A new art history brought with it a host of new or restated concerns: "gender, race, class" form a by now familiar litany. Hence, along with arguments informed by literary theory and postmodern philosophy, arrived other newer, or at least subtler, approaches to questions concerning the socioeconomic aspects of art. More recently, and more to the point of this collection, increasingly sophisticated studies of the commercial and economic aspects of art of the early modern period have also appeared. The works cited by Pamela H. Smith and Paula Findlen in their introduction are just some among the noteworthy publications which have illuminated commercial and economic aspects of art in the Low Countries, Germany, and Italy.[12]

Similar tendencies emerged more or less simultaneously in the historiography of science. While older surveys still marked out the course of scientific ideas, the same years (the early 1970s) that saw a new art history also witnessed numerous expressions of a social history of science.[13] Similar sorts of concerns were expressed: an increasing number of studies, including those by some of the contributors to this volume, deal with the institutional nexus, patronage relations, and personal networks of practitioners of science.[14] As signaled by recent books on canonical figures such as Galileo Galilei and Tycho Brahe, the social history of science has grown increasingly sophisticated, with far-reaching implications.[15] It has now been argued that even the determination of scientific "truth" may be socially constructed.

This importance of social practices for the determination of knowledge, in the thesis advanced by Stephen Shapin, recalls some of the arguments of Michel Foucault—whom Shapin indeed cites.[16] In books not however cited by Shapin, Foucault, to use his own diction, had enunciated an archaeology of knowledge,[17] and, more relevant to issues here, had suggested an "order of things" which offered a view of sequentially changing epistemic systems. For Foucault the "classic" period (roughly, of the "long" seventeenth century, to use another term initiated in francophone historiography) was marked by the episteme of representation. In the preface to Foucault's *The Order of Things* this idea was in turn "represented" by a famous painting, *Las Meninas* of Velázquez. Furthermore, Foucault also spoke of "exchanging" as well as classifying as characteristic of the classic period.[18]

Foucault thus opened the path followed by many essays in this collection. Foucault's articulation of a concern with the idea of "representation," and its manifestations in epistemology, science, and art is reflected in the general framing of the present collection; it resonates most clearly in essays like Claudia Swan's, where epistemological concerns for classification are linked to forms of artistic representation, and associated with the origins of a genre of painting, the independent still life. Likewise, Foucault's association of epistemological concepts of value with economic ones in the classic period is reflected in the coupling of commerce with representation in art and science in numerous other essays in this collection.

As the editors of this volume reiterate in their introduction, many scholars in the twentieth century were certainly concerned with the way in which art aids science, and science art, in the representation of the world. Richard Rorty's critique of the philosophical mirror of nature demonstrates that philosophers other than Foucault have also questioned the notion of representation of truth as an adequate or accurate conception for epistemology.[19] In addition to an increasing literature on the interactions of art and science, there has arisen an interest in the interrogation of the concept of "representation," its many connotations and manifestations, as well as its social con-

struction and determination. The birth and early success of the periodical *Representations* occurred in this atmosphere, as did the work of authors who were initially associated with it.[20] Moreover, and independent of these tendencies, other discourses on the human sciences have taken newer directions into the investigation of the often fraught interactions of artistic and scientific representation.[21]

In an essay published a decade ago in a volume titled *Art in History, History in Art*, David Freedberg picked up many of these strands, and wove them together in a polemic on the relations of art, science, and commerce.[22] Speaking specifically about seventeenth-century Dutch culture, Freedberg argued that many of the interconnections that lie between these supposedly separate realms of activity had been ignored. He challenged scholars to address issues that seem to be located in such interstices between related but apparently different disciplines.

This collection replies to Freedberg's challenge, bringing together a variety of essays that link art, science, commerce, and representation. Moreover, even if it must be said that fields are not always treated in the same piece, the ways in which connections have been made also correspond to fresher socioeconomic approaches. The stress on commerce, on instruments used, and on objects studied means that practices, not theories, activities, nor attitudes, are emphasized in the historiography of science. Networks, exchanges, and extraneous objects are here the topics for history of science, as for one of art, rather than scientists, systems, or for that matter masterpieces.

In addition to merchants, mechanics—meaning those who work with their hands or have a trade, not the classic physical science called mechanics, the laws of which were adduced by Galileo and Isaac Newton—might thus seem to have taken center stage. In keeping with other recent syntheses and collections of studies, this move indicates a shift in approach away from a concern with the history of physics and astronomy, which had been a main focus for a traditional history of science, to one in which natural history and other subjects such as cartography or geography come to the fore as ways of mapping nature.[23] Similarly, even in paintings with religious subjects, not figures, but elements pertaining to what were to emerge as new, but were regarded as lower genres—landscape, animal painting, and still life—engage art history.

At the same time that these essays point to more paths for investigation, they also provoke further consideration of some of the theses which they advance. Engineers and instrument makers surface at several places in this book, as in James Bennett's essay. This corresponds to a trend in which engineers (and to a lesser degree instrument makers) have increasingly been seen not only as ancillary to the development of the natural sciences, but to epitomize the connection between art and science in the Renaissance. As instan-

tiated by figures from Filippo Brunelleschi or Leon Battista Alberti to Leonardo da Vinci, skills in engineering and instrument making were closely associated with art and architecture in the Italian Renaissance.[24] The paradigmatic "artist-scientist-genius"[25] so personified by Panofsky half a century ago has yielded to the artist–scientist-engineer engaged in designing fortifications, making waterworks, instruments, and works of art.

Such figures were to be found over a much longer period of time and in many more places than Renaissance Florence. Although not so famous, the position of instrument maker–scientists such as Jobst Bürgi between art and science has in fact gained some attention.[26] But there are many other figures such as Simon Stevin or Salomon de Caus who could claim a place equally in histories of seventeenth-century art and architecture, as they have done in those of mechanics or mathematics. While the previous segregation of national and disciplinary historiographies seems to have led to their comparative neglect, De Caus has recently been recognized as a perspective theorist, and as designer of "mechanical contrivances," and Stevin's work has been called "deeply characteristic of Dutch activities—scientific and practical—at this time (i.e., the early seventeenth century)."[27] De Caus was also directly involved not only with hydraulic theory, but with garden (and hence garden fountain-sculpture design); Stevin also was much interested in architecture, on which he penned a treatise.[28]

With figures such as De Caus, Stevin, and their older Netherlandish contemporary Hans Vredeman de Vries, it is hard to separate the scientist or engineer from the artist or architect. Vredeman de Vries also made waterworks, served as master of fortifications (*Festungsbaumeister*) in both Wolfenbüttel and Gdańsk (Danzig), but he is equally well known, if not more famous in art and architectural history as the author of important treatises on perspective and on the architectural orders. Vredeman de Vries was also a prolific draftsman and painter.[29] Hence the story that Berkel tells here about the Netherlandish practitioner calls up a pattern established by the efforts and interests of other, more important figures; indeed, famous figures such as Andreas Schlüter remained active in the intersections of art, science, and engineering into the eighteenth century.[30]

The lengthy survival or recurrence of such supposedly distinctive Renaissance phenomena raises considerations of periodization, and thus leads to other questions about the conceptualization of this collection. The definition of commerce posited here is a broader one, that encompasses various kinds of exchange, not only of trade, for example, of trade, but also of gift-giving. Economic practices are thus described as having a longer purchase, as it were. Consequently, Weberian notions that economic rationalism could be linked with capitalism and with the Reformation (or Renaissance), and thus connected with definitions of historical periods seems to be rejected. In a

world in which a prince could offer to trade a colony for a collection, or courts could bankrupt themselves with expenditures on luxuries in a desire to express their magnificence, it may well be that period distinctions based on notions of economic rationality are not the best markers of modernity.[31]

Instead, representational practices provide the basis for the period definitions assumed here. Pamela Long argues most directly for these sorts of distinctions in her essay on the relation of visual representation to the investigation of nature. She contrasts what she finds to be the use of forms of visual representation to legitimate knowledge claims in the period 1490–1540s with what she describes as the antecedent, ancient, and medieval reluctance "to use visual images to demonstrate claims" about the natural world.

But what are the implications of this thesis? Clearly many examples exist of images from antiquity and the Middle Ages that were used to illustrate scientific texts, to demonstrate an argument. As exemplified by herbals and later by *tacuina sanitatis*, numerous illuminated manuscripts pertaining to medicine and natural history survive from antiquity, and in larger numbers through the Middle Ages.[32] Moreover, other kinds of "scientific" texts, notably astrological and alchemical handbooks, were also illustrated during the Middle Ages, and there is evidence that some such sorts of works may have been in antiquity as well.[33] These are, furthermore, some of the very fields—natural history and alchemy—that form the focus for discussion in this collection.

Accordingly, the period and category distinctions employed here cannot be seen to rely simply on the presence of empirical evidence. Rather, it is the quality of the evidence concerned that is important. And this leads back, as indeed is suggested in part by Long's essay, to another look at the development of representational forms and skills. Yet such an investigation also leads further into a more extended history of artistic forms and practices, into questions of artistic endeavor of an art historical nature—one which, however, is not directly addressed in this book.[34] The thesis that there was a reluctance to rely on visual evidence for truth claims is in fact based on the evidence of theory, not practice, and the theoretical considerations seem to derive, as Long indicates, from discussions of mechanics. This raises a fundamental question: To what extent did a mathematical worldview offer a different perspective on visual representation of nature?

Mechanics and celestial mechanics, or astronomy, are also not treated in this book. But consideration of these subjects is of importance not just for their implications for questions of periodization, but also for more general issues concerning commerce and representation that are central to this collection. Astronomy had immense commercial importance in the period here discussed, certainly at least in its astrological form.[35] Almanacs, ephemerides, and horoscopes circulated widely and seem to have been avidly acquired.

New astronomical phenomena were eagerly reported and became the "hot news" of the day.[36] Astronomers were highly sought after and regarded by courts, whom they served in various capacities, not just for casting horoscopes. Significantly, Tycho Brahe received many privileges from the Danish crown; he then became the highest paid servitor of the imperial court.[37]

Moreover, attention to mechanics, especially to celestial mechanics, sheds a different light on issues of representation in art and science. Whether or not one agrees with an older thesis that regards the "Scientific Revolution" as connected with the mechanization of the world picture,[38] developments in mechanics were certainly related to advances in mathematics. These relied on other forms of representation, utilizing quantification and systems for indicating it.[39] For practitioners of mathematically based sciences such as astronomy, nature was to be read not in images, but in numbers. Ultimately the increasing sophistication and difficulties involved with mathematics, related to the development of professional specialization,[40] in fact split the union that had existed between art, science, and engineering. But such developments were not of course imaginable until the end of the early modern period.

Not all natural philosophers gave images the same meaning. Differences in opinion about the significance of visual imagery were in fact already evident in the early seventeenth century, in the "Kepler-Fludd controversy." While Fludd believed that the cosmos could be represented in images and diagrams, Kepler treated these images as at best symbolic, and denied that they, or other similar images, could represent reality (even though he himself was a master of the scientific diagram and had famously made a model of the universe based on the inscription of the Platonic [Pythagorean] solids. Mathematics, not pictures, was to be trusted in the end.[41] Considerations of cosmology had thus already led to what can be called a crisis of confidence in the image, at least in the realm of astronomy after Copernicus, at the very time in which the idea of a "true" image of nature could thrive in such fields as anatomy and natural history. While science and art could continue to coexist, this position may be regarded as the initiation of a theme, advanced by the Enlightenment, by which images would come to be regarded as deceptive.[42]

The visual revolution of our own time reminds us, however, that there are many views of the importance of image making. There are still many diverse opinions about systems of representation and their relation to nature. While new forms of biology and biotechnology have revolutionized conceptions of life itself, new kinds of visual imaging have proliferated, and those also make claims to represent reality and call for a new understanding of visuality related to newer discourses in the humanities and social sciences.[43] But the issues and apparent contradictions suggested by the early modern period are also still with us. The physical sciences still strive to produce a unified theory, and biological scientists also claim that all science, indeed all

knowledge, may be explained by a single unified theory.[44] Moreover, many of these questions, concerning computers, biotechnology, physical fusion, have vast commercial implications. A virtue of this collection of essays is that it not only stimulates reconsiderations of the historiography of worldviews, but that in so doing it encourages reconsideration of the role of representation, commerce, image-making, and science in the contemporary world.

Notes

1. The remarks made here pertain to more general issues raised by the book, and therefore refrain from commenting on more particular arguments in individual essays.

2. This distinction between an "internal" historiography of science and its alternatives is made by Thomas DaCosta Kaufmann, "Empiricism and Community in Early Modern Science and Art: Some Comments on Baths, Plants, and Courts," in *Natural Particulars. Nature and the Disciplines in Renaissance Europe*, ed. Anthony Grafton and Nancy Siraisi (Cambridge, Mass. and London: MIT Press, 1999, 401f. For the historiography of the Scientific Revolution see most comprehensively H. Floris Cohen, *The Scientific Revolution. A Historiographical Inquiry*, (Chicago and London: University of Chicago Press, 1994).

3. A. C. Crombie, *From Augustine to Galileo* (Harmondsworth: Penguin Books, 1959; 1st ed., 1952).

4. Edwin A. Burtt, *Metaphysical Foundations of Modern Physical Science*, (New York: Harcourt Brace, 1932, rev. ed.; 1st ed. 1924).

5. The works of all these scholars are now largely accessible in translation. See, for example, Heinrich Wölfflin, *Principles of Art History. The Problem of the Development of Style in Later Art*, trans. E. Hottinger (New York: Dover, 1950; 1st English ed., 1932); *Classic Art*, trans. Peter and Linda Murray (London: The Phaidon Press, 1952); *Renaissance and Baroque*, trans. Kathrin Simon, intro. Peter Murray (Ithaca, N.Y.: Cornell University Press, 1964); Alois Riegl, *Problems of Style. Foundations for a History of Ornament*, trans. Evelyn Kain, annotations and intro. David Castriota, preface Henri Zerner, (Princeton, N.J.: Princeton University Press, 1992); *The Group Portraiture of Holland*, trans. Evelyn M. Kain and David Britt, intro. Wolfgang Kemp (Los Angeles: Getty Research Institute for History of Art and the Humanities, 1999); Émile Mâle, *The Gothic Image*, trans. (New York, 1952). They have also garnered significant historiographical attention. [See, for example, For Mâle.] Germain Bazin, *Histoire de l'histoire de l'art de Vasari à nos jours* (Paris: Albin Michel, 1986), 208–210 (in a chapter titled "Les pouvoirs de l'image: l'iconographie").

6. See, for example, Richard S. Westfall, *The Construction of Modern Science. Mechanisms and Mechanics* (Cambridge: Cambridge University Press, 1971); Sydney J. Freedberg, *Painting in Italy 1500–1600 (The Pelican History of Art)* (Harmondsworth: Penguin Books, 1971).

7. Warburg's essays, including many papers touching on astrology, are now accessible in an English translation: Aby Warburg, *The Renewal of Pagan Antiquity: Contributions to the Cultural History of the European Renaissance*, trans. David Britt, intro. Kurt W. Forster (Los Angeles: Getty Research Institute for History of Art and the Humanities, 1999). See further Fritz Saxl, *Lectures* (London: Warburg Institute, 1957). Panofsky's early German essays on proportion and perspective are also available in translation: "The History of the Theory of Human Proportions as a Reflection of the History of Style," in *Meaning in the Visual Arts* (Garden City, N.Y.: Doubleday Anchor Books, 1955), 55–107; *Perspective as Symbolic Form*, trans. Christopher Wood (Cambridge, Mass.: Zone Books [MIT Press], 1991).

8. Martin Wackernagel, *The World of the Florentine Renaissance Artist. Projects and Patrons, Workshop and Art Market*, trans. Alison Luchs (Princeton, N.J.: Princeton University Press, 1981; 1st ed. Leipzig, 1938); Hans Floerke, *Studien zur niederländischen Kunst- und Kulturgeschichte. Die Formen des Kunsthandels, das Atelier und die Sammler in den Niederlanden vom 15.–18. Jahrhundert* (Munich and Leipzig: Georg Müller, 1905).

9. Robert K. Merton, *Science, Technology and Society in Seventeenth-Century England* (New York: Harper & Row, 1970; 1st ed. 1938); Herbert Butterfield, *The Origins of Modern Science* (New York: Macmillan, 1957; 1st ed. London, 1949). For the impact of the latter work, see Robert S. Westman and David C. Lindberg introduction to *Reappraisals of the Scientific Revolution*, ed. Westman and Lindberg, (Cambridge, Cambridge University Press, 1990), xvii.

10. For example, Frederick Antal, *Florentine Painting and its Social Background. The Bourgeois Republic before Cosimo de Medici's Advent to Power*, (London: Kegan Paul, 1947); Arnold Hauser, *Social History of Art*, trans. Stanley Godman (New York: Random House, 1951), 2 vols.; J. D. Bernal, *Science in History*, (Cambridge, Mass.: MIT Press, 1971), 4 vol. (1st ed. London, 1954).

11. I have dated the appearance of the "new art history," at least in its self-proclamation, to 1972 in a response to a "Visual Culture Questionnaire," *October* 77, 1996: 45–8. See further "What Is New about the 'New Art History,'" *The Philosophy of the Visual Arts*, ed. Philip Alperson (New York and Oxford: Oxford University Press, 1992), 515–520.

12. In addition to the titles cited by Smith and Findlen, see, for example, Richard A. Goldthwaite, *The Building of Renaissance Florence. An Economic and Social History* (Baltimore and London: Johns Hopkins University Press, 1980); Neil de Marchi and Hans J. Van Migroet, "Novelty and Fashion Circuits in the Mid-Seventeenth Century Antwerp-Paris Art Trade," *Journal for Medieval and Early Modern Studies* 28 (1998) 201–246; *idem*, "Exploring markets for Netherlandish Paintings in Spain and Nueva España," *Nederlands Kunsthistorisch Jaarboek* (2000): 80–111; Bernd Roeck, *Kunstpatronage in der Frühen Neuzeit* (Göttingen: Vandenhoeck & Ruprecht, 1999).

13. Alan G. R. Smith, *Science and Society in the Sixteenth and Seventeenth Centuries* (London and New York: Science History Publications, 1972). A new edition of Merton's *Science, Technology and Society* was also published in 1970.

14. Among the volume of recent literature, an exemplary collection is *Patronage and Institutions. Science, Technology, and Medicine at the European Court 1500–1700*, ed. Bruce T. Moran (Rochester, N.Y., and Woodbridge: Boydell Press, 1991), including essays by Smith and Findlen. See also their other publications, and studies by other scholars cited in essays above.

15. Mario Biagoli, *Galileo Courtier. The Practice of Science in the Culture of Absolutism* (Chicago and London: University of Chicago Press, 1993); John Robert Christianson, *On Tycho's Island. Tycho Brahe and His Assistants 1570–1601*, (Cambridge: Cambridge University Press, 2000).

16. Steven Shapin, *The Social History of Truth. Civility and Science in Seventeenth-Century England* (Chicago and London: University of Chicago Press, 1994), 36–38, citing Foucault. See further Shapin's more recent synthesis *The Scientific Revolution* (Chicago and London: University of Chicago, 1996), emphasizing the social practices of science.

17. See Michel Foucault, *L'archéologie du savoir* (Paris: Gallimard, 1969).

18. Michel Foucault, *The Order of Things. An Archaeology of the Human Sciences* (New York: Pantheon Books, 1970), English trans. of *Les Mots et les choses* (Paris: Gallimard, 1966).

19. Richard Rorty, *Philosophy and the Mirror of Nature* (Princeton, N.J.: Princeton University Press, 1979).

20. Notably Stephen Greenblatt, *Renaissance Self Fashioning From More to Shakespeare* (Chicago and London: University of Chicago Press, 1980); Svetlana Alpers, *The Art of Describing. Dutch Art in the Seventeenth Century* (Chicago and London: University of Chicago Press, 1983).

21. Exemplified by Barbara Maria Stafford, *Body Criticism. Imaging the Unseen in Enlightenment Art and Medicine* (Cambridge, Mass. and London: MIT Press, 1991); *Artful Science.*

Enlightenment Entertainment and the Eclipse of Visual Education (Cambridge, Mass. and London: MIT Press, 1994); *Good Looking. Essays on the Virtue of Images* (Cambridge, Mass. and London: MIT Press, 1996).

22. "Science, Commerce, and Art: Neglected Topics at the Junction of History and Art History," in *Art in History. History in Art. Studies in Seventeenth-Century Dutch Culture*, ed. David Freedberg and Jan de Vries (Santa Monica: Getty Center for the History of Art and Humanities, 1991), 376–428. Freedberg's essay has been excerpted, "Ciência, Comércio e Arte. Topícos negligenciados na junção da histórí a[historia] com a história da arte (excertos)," in *O Brasil e os Holandeses 1530–1654*, ed. Paulo Herkenhoff (Rio de Janeiro: Sextante Artes, 1999), 192–217.

23. Grafton and Siraisi, *Natural Particulars. Nature and the Disciplines in Renaissance Europe*.

24. Bertrand Gille, *Les ingénieurs de la Renaissance* (Paris: Hermann, 1964), is an older introduction to the topic. See also for an overview Paolo Galluzzi, *Renaissance Engineers from Brunelleschi to Leonardo da Vinci* (Florence: Istituto e Museo di Storia della scienza, 1996) and Hélène Vénn, *La gloire des ingénieurs* (Paris: Albin Michel, 1993).

25. See Erwin Panofsky, "Artist, Scientist, Genius: Notes on the 'Renaissance-Dämmerung,'" in *The Renaissance. Six Essays*, ed. Wallace K. Ferguson (New York: Harper & Row, 1962), 121–182 (initially given in a lecture series at the Metropolitan Museum of Art, New York, 1951–52).

26. Because of his importance for the history of mathematics, horology, and astronomy, Bürgi, who crafted exquisite objects that became elements of princely collections, may be picked out as exemplifying this tendency. For literature on Bürgi, see Ludolf von Mackensen, ed., *Die erste Sternwarte Europas mit ihren Instrumenten und Uhren. 400 Jahren Jost Bürgi in Kassel* (Munich: Callway, 1988; 3rd improved ed.; 1st ed. 1979), and for a more recent summary *idem*, "Die Kasseler Wissenchaftskammer oder die Vermessung des Himmels, der Erde und der Zeit," in *Moritz der Gelehrte. Ein Renaissancefürst in Europa*, ex. cat. ed. Heiner Borggrefe, Eurasburg, 1997, 385–390, with catalog entries 391ff.

27. Martin Kemp, *The Science of Art. Optical Themes in Western Art from Brunelleschi to Seurat* (New Haven and London: Yale University Press, 1990), 112–118; Kemp comments: "Stevin and his fellow mathematicians were concerned with an astonishing range of applied skills and technologies—fortifications, guns, ships, canals, navigation windmills, cranes modes of transport, timepieces, surveying, accounting, banking, and certainly not least, the optical instruments such as the telescope and microscope that were been exploited to revolutionize the visual data of science"(114).

28. With characteristic insight, Frances Yates recognized De Caus's multiple talents and importance. See *The Rosicrucian Enlightenment* (London and Boston: Routledge and Kegan Paul, 1972), 11–13 passim. For De Caus, see Piet Lombaerde, "Pietro Sardi, Georg Müller, Salomon de Caus und die Wasserkünste des Coudenberg-Gartens in Brüssel," *Gartenkunst* 3, 1991: 159–171; idem, "Die Wasserkünste des Coudenbergparks in Brüssel," in *Die Wasserversorgung in der Renaissancezeit*, ed. Albrecht Hoffmann (Mainz: Von Zuben, 2000), 277–84. An edition with commentary of Stevin's architectural treatise is being prepared by Charles van den Heuvel; in the meantime see *idem*, "Stevins 'huisbouw' en het onvoltooide Nederlands architectuurtractaat. De praktijk van hat bouwen als wetenschap," *Bulletin van de Konijklijke Nederlandse Oudheidkundige Bond* 93 (1994): 1–18.

29. Vredeman de Vries is the subject of a forthcoming exhibition in Lemgo which will illuminate many of his qualities. An essay by Lombarde and Van den Heuvel promises further to relate his many-sided talents to those of De Caus and Stevin. See Petra Sophia Zimermann, "Die Palastenentwürfe des Hans Vredeman de Vries in der 'Architectura' von 1577," in *Italienische Renaissancebaukunst an Scheide, Maas und Niederrhein: Stadtanlagen–Zivilbauten–Wehranlangen: Tagungshandbuch (2. Jülicher Pasqualini-symposium vom 18. bis 21. Juni 1998 in Jülich)*, ed. Günter Bers and Conrad Doose, Jülich, 1999; 335–337 (summary on 621–622), with references to earlier studies.

30. For example, Andreas Schlüter, for whom in this regard see Thomas DaCosta Kaufmann, "Schlüter's Fate. Comments on Sculpture, Science, and Patronage in Central and Eastern Europe c. 1700," in *Künstlerische Austausch/ Artistic Exchange. Akten des XXVIII. Internationalen Kongresses für Kunstgeschichte Berlin, 15.–20. Juli 1992*, Berlin, Akademie Verlag, 1993, 199–212.

31. The first story is told by Pamela H. Smith, *The Business of Alchemy. Science and Culture in the Holy Roman Empire* (Princeton, N.J.: Princeton University Press, 1994), 171–192. The overwhelming impact of expenses on luxuries and magnificence is familiarly given as a reason for the bankruptcy of the French crown in the eighteenth century, and the same occurred elsewhere, as for example in Bavaria.

32. See, for a general introduction, Wilfrid Blunt, with the assistance of William T. Stearn, *The Art of Botanical Illustration. An Illustrated History* (London: Collins, 1950), 5ff. For an introduction to *tacuina sanitatis* and their relation to the herbal, see Luisa Cogliati Arano, *The Medieval Health Handbook* (New York and London: Barrie & Jenkins, 1976). For a recent publication related to an ancient example, see Cesare Ruffato, ed., *La medicina in Roma antica. Il Liber medicinalis di Quinto Sereno Sammonico* (Turin: UTET, 1996).

33. For an illustrated overview of alchemical manuscripts and books, see Gareth Roberts, *The Mirror of Alchemy. Alchemical Ideas and Images in Manuscripts and Books. From Antiquity to the Seventeenth Century* (London: British Library, 1994). Astrological handbooks were discussed long ago by Warburg, Saxl, and their followers; see note 7 above. For a general overview, see Kurt Weitzmann, *Ancient Book Illumination* (Cambridge, Mass.: Harvard University Press, 1959), not without questions, however.

34. For a very recent approach to the question of the origin of still life in Italy which, taking into account other literature, discusses historical and art historical questions, see Giacomo Berra, "Arcimboldi, Vincenzo Campi, Figino, Fede Galizia, Caravaggio: congiunture sulla nascita della natura morta in Lombardia," in *Vincenzo Campi: scene del quotidiano*, ex. cat., ed. Franco Paliaga, Milan and Cremona, 2000, 61–86. I deal with this in a forthcoming essay.

35. For a discussion of some aspects of the commercial relations of astrology see most recently Anthony Grafton, *Cardano's Cosmos* (Cambridge, Mass.: Harvard University Press, 1999).

36. This is the subject of ongoing research by Eileen Reeves.

37. In addition to the work by Christianson, *On Tycho's Island*, see for Brahe's later career Victor E. Thoren, *The Lord of Uraniborg. A Biography of Tycho Brahe* (with contributions by Christianson) (Cambridge: Cambridge University Press, 1990), 376ff. For the point about Tycho's salary see Alphons Lhotsky, "Die Geschichte der Sammlungen," *Festschrift des Kunsthistorischen Museums in Wien 1891–1941*, pt. 2, Vol. 1, p.295.

38. Cf. E. J. Dijksterhuis, *The Mechanization of the World Picture* (Oxford: Clarendon Press, 1961; 1st ed. Amsterdam, 1950).

39. See Alfred W. Crosby, *The Measure of Reality. Quantification and Western Society 1250–1600* (Cambridge: Cambridge University Press, 1997).

40. See J. V. Field, *The Invention of Infinity. Mathematics and Art in the Renaissance* (Oxford, New York, Tokyo: Oxford University Press, 1997), 229ff.

41. See for these points the insightful essay by Robert Westman, "Nature, Art, and Psyche: Jung, Pauli, and the Kepler-Fludd Polemic," in *Occult and Scientifc Mentalities in the Renaissance*, ed. Brian Vickers (Cambridge: Cambridge University Press, 1984), 177–230.

42. This subject has been well elucidated by Barbara Stafford, *Body Criticism*, and *Artful Science*.

43. See Barbara Stafford, *Good Looking*.

44. See Edward Osborne Wilson, *Consilience. The Unity of Knowledge* (New York: Knopf, 1997).

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